

CONTROL NO. C-73322

DATE 26 NOVEMBER 1962

REVISED _____

TO -
CLASSIFICATION CHANGE
UNCLASSIFIED
By Authority of ASST. Dir.
Changed by ASST. Dir. Date 11/26/62

MERCURY SPACECRAFT NO. 15A
CONFIGURATION SPECIFICATION (U)
(MERCURY - ATLAS NO. 10)

GP-4

REPORT 6603-15A

COPY NO. 14

560 5308

MCDONNELL aircraft corp.,
St. Louis, Mo.

AVAILABLE TO U.S. GOVERNMENT AGENCIES ONLY

This material contains information affecting the national defense of the United States within the meaning of the Espionage Laws, Title 18 U.S.C., Sections 793 and 794, the transmission or revelation of which in any manner to an unauthorized person is prohibited by law.

SUBMITTED UNDER National Aeronautics and Space Administration
(NASA Contract NAS 5-59)

PREPARED BY M. Abramson APPROVED BY F. J. Smith
M. Abramson 26 Nov 1962 reg F. J. Smith

APPROVED BY L. M. Parker APPROVED BY _____
L. M. Parker

DATE 26 November 1962**MCDONNELL**

ST. LOUIS, MISSOURI

PAGE 1

REVISED _____

REPORT 6603-15A

REVISED _____

~~CONFIDENTIAL~~MODEL Mercury SpacecraftTABLE OF CONTENTS

<u>PARAGRAPH</u>	<u>TITLE</u>	<u>PAGE NO.</u>
Title Page		
1.0	SCOPE AND CLASSIFICATION	1
1.1	Scope	1
1.1.1	Mission	1
1.1.1.1	Objectives	1
2.0	APPLICABLE SPECIFICATIONS AND OTHER PUBLICATIONS	3
2.1	References	3
2.1.1	Precedence	3
2.2	Process Specifications	3
2.3	Contract Change Proposals	5
2.4	Request for Alteration	8
3.0	REQUIREMENTS	10
3.1	Characteristics	10
3.1.1	Weight and Balance	10
3.1.1.1	Gross Weight	10
3.1.1.2	Launch Weight	10
3.1.1.3	Orbit Weight	10
3.1.1.4	Re-Entry Weight	10
3.1.1.5	Abort Weight	10
3.1.1.6	Impact Weight	10
3.1.1.7	Weight and Balance Summary	11
3.2	General Description	14
3.2.1	Configuration	14
3.2.2	Selection of Materials	15
3.2.3	Fabrication	15
3.2.4	Interchangeability and Replaceability	15
3.2.5	Finish	15
3.2.6	Identification and Marking	15
3.2.7	Extreme Environmental Requirements	15
3.2.8	Lubrication	17
3.2.9	Reliability	17
3.3	Aerodynamic and Hydrodynamic Considerations	18
3.4	Structural Design Criteria	18
3.5	Spacecraft	19
3.5.1	Description	19
3.5.2	Construction	19
3.5.3	Entrance and Emergency Egress Hatch	19
3.5.4	Exit Hatch	20
3.5.5	Window and Filter	20
3.5.5.1	Window	20
3.5.5.2	Filter	21

~~CONFIDENTIAL~~

MCDONNELLDATE 26 November 1962

ST. LOUIS, MISSOURI

PAGE 11

REVISED _____

REPORT 6603-15A

REVISED _____

~~CONFIDENTIAL~~MODEL Mercury SpacecraftTABLE OF CONTENTS - (Continued)

<u>PARAGRAPH</u>	<u>TITLE</u>	<u>PAGE NO.</u>
3.5.6	Antenna Assembly	22
3.5.7	Antenna Cover	22
3.5.8	Umbilical Door	22
3.6	Heat and Micrometeorite Shielding	23
3.6.1	Forebody Heat Protection	23
3.6.2	Afterbody Heat Protection	23
3.6.3	Micrometeorite Protection	23
3.7	Booster Adapter	24
3.8	Crew Station	25
3.8.1	Astronaut Support Couch	25
3.8.1.1	Construction	25
3.8.2	Astronaut Restraint System	25
3.8.3	Astronaut Apparel	26
3.8.4	Food and Water	26
3.8.5	Miscellaneous Equipment	27
3.8.5.1	Special Equipment Container	27
3.8.5.2	Window Pole and Flashlight Installation	27
3.8.6	Noise and Vibration	27
3.8.7	Aeromedical Sensing Equipment	27
3.8.7.1	Electrocardiogram	28
3.8.7.2	Respiration Sensing System	28
3.8.7.3	Body Temperature	28
3.8.7.4	Blood Pressure Measuring System	28
3.8.8	Consoles and Controls	28
3.8.8.1	Consoles	28
3.8.8.1.1	Right-Hand Console	28
3.8.8.1.2	Left-Hand Console	29
3.8.8.2	Controls	29
3.8.8.2.1	Hand Controller	29
3.8.8.2.2	Abort Handle	30
3.8.9	Instrumentation and Displays	30
3.8.9.1	Satellite Clock	34
3.8.9.2	Angular Rate and Attitude Indicator	34
3.8.9.3	Acceleration Indication	35
3.8.9.4	Sequence System and Override Controls	35
3.8.9.4.1	Warning Lights	36
3.8.9.5	Indicator Lights	37
3.8.9.6	Switches and Handles	38
3.8.9.7	Fuse Switches	41
3.8.10	Lighting	42
3.9	Spacecraft Environmental Control	45
3.9.1	Environmental Control System	45

~~CONFIDENTIAL~~

MCDONNELLDATE 26 November 1962

ST. LOUIS, MISSOURI

PAGE 111

REVISED _____

REPORT 6603-15A

REVISED _____

~~CONFIDENTIAL~~MODEL Mercury SpacecraftTABLE OF CONTENTS - (Continued)

<u>PARAGRAPH</u>	<u>TITLE</u>	<u>PAGE NO.</u>
3.9.1.1	Description	45
3.9.1.2	Operational Sequence	46
3.9.1.2.1	Prelaunch	46
3.9.1.2.2	Launch	47
3.9.1.2.3	Orbital	47
3.9.1.2.4	Re-Entry	48
3.9.1.2.5	Post-Landing	48
3.9.1.3	Operational Modes	48
3.9.1.4	Environmental Control System Warning Indication	49
3.10	Stabilization and Control Subsystem	50
3.10.1	Automatic Stabilization and Control System	50
3.10.1.1	Modes of Operation	50
3.10.1.2	Sequence of Operation	50
3.10.2	Horizon Scanner System	52
3.10.3	Reaction Control System	52
3.10.3.1	Automatic Control Subsystem	53
3.10.3.2	Manual Control Subsystem	53
3.10.3.3	Operation	53
3.10.3.4	Tanks	54
3.11	Retrograde Rocket System	56
3.11.1	Description	56
3.11.2	Installation	56
3.11.3	Ignition	56
3.11.4	Posigrade Rocket System	57
3.12	Escape System	58
3.12.1	Description	58
3.12.2	Escape Rocket	58
3.12.3	Pylon Jettison Rocket	58
3.12.4	Escape System Performance	59
3.12.5	Escape System Sequence	59
3.12.5.1	Normal Mission	59
3.12.5.2	Aborted Mission	62
3.12.5.2.1	Abort Initiation	62
3.12.5.3	Abort Sequence Off-the-Pad and Prior to Tower Separation	63
3.12.5.4	Abort Sequence After Tower Separation	64
3.13	Electrical Power Supply System	67
3.13.1	Main Power Supply	67
3.13.2	Standby Power	67
3.13.2.1	Isolated Power	67
3.13.3	AC Power System	68
3.13.3.1	Main AC Power System	68
3.13.3.2	Standby AC Power	68

MCDONNELLDATE 26 November 1962

ST. LOUIS, MISSOURI

PAGE iv

REVISED _____

REPORT 6603-15A

REVISED _____

~~CONFIDENTIAL~~MODEL Mercury SpacecraftTABLE OF CONTENTS - (Continued)

<u>PARAGRAPH</u>	<u>TITLE</u>	<u>PAGE NO.</u>
3.13.4	Electrical Connections	68
3.13.4.1	Umbilical Connections	68
3.14	Communications System	72
3.14.1	Two-Way HF/UHF Orbital Voice Communication	72
3.14.1.1	Audio Center	72
3.14.1.2	Astronaut's Headset/Microphone Assemblies	73
3.14.2	Command Receiver System	73
3.14.3	Telemetry	73
3.14.3.1	Telemetry Transmitter	73
3.14.3.2	Telemetry Power Supply	74
3.14.4	Transponders and Beacons	74
3.14.4.1	C-Band Beacon	74
3.14.4.2	S-Band Beacon	74
3.14.4.3	Recovery Aids	74
3.14.4.3.1	HF/UHF Rescue Beacon	74
3.14.4.3.2	UHF Auxiliary Rescue Beacon	74
3.14.5	Communications Control Panel	75
3.14.6	Antennas	75
3.14.6.1	C and S-Band Antenna	75
3.14.6.2	Bicone Antenna	76
3.14.6.2.1	Multiplexer	76
3.14.6.3	UHF Descent Antenna	76
3.14.6.4	HF Rescue Antenna System	76
3.14.6.5	HF Diplexer	76
3.14.6.6	UHF Rescue Beacon Antenna	76
3.14.6.7	HF Dipole Antenna	76
3.14.7	Coaxial Switches	77
3.14.8	Coaxial Cables and Connectors	77
3.14.9	Bicone Isolator	77
3.15	Recording Equipment	78
3.15.1	Utility Camera	78
3.15.2	Tape Recorder	78
3.15.2.1	Commuted Data Recording	79
3.15.2.1.1	Low-Level Commutator	80
3.15.3	Cosmic Ray Film Pack	80
3.15.4	Data Programmer	80
3.15.5	Voltage Controlled Subcarrier Oscillators	80
3.15.5.1	Reference Oscillator	80
3.15.6	Isolation Amplifier	80
3.15.7	Special Instrumentation	81
3.16	Navigational Aids	84
3.16.1	Navigational Aid Kit	84

~~CONFIDENTIAL~~

MCDONNELLDATE 26 November 1962

ST. LOUIS, MISSOURI

PAGE _____ V

REVISED _____

REPORT 6603-15A

REVISED _____

~~CONFIDENTIAL~~MODEL Mercury SpacecraftTABLE OF CONTENTS - (Continued)

<u>PARAGRAPH</u>	<u>TITLE</u>	<u>PAGE NO.</u>
3.16.1.1	Stereographic Maps	84
3.16.1.2	Cards	84
3.16.1.3	Pencil	84
3.16.2	Optical Attitude Reference	84
3.17	Landing, Post-Landing, and Survival System	85
3.17.1	Landing System	85
3.17.1.1	Drogue Parachute System	85
3.17.1.2	Main Parachute System	85
3.17.1.3	Pilot Parachute	86
3.17.1.4	Reserve Parachute	87
3.17.2	Impact Skirt	87
3.17.3	Post-Landing System	88
3.17.3.1	Fluorescein Dye Marker	88
3.17.3.2	Shark Repellent	88
3.17.3.3	Flashing Recovery Light	88
3.17.3.4	SOFAR Bomb	88
3.17.3.5	Impact Sensor	89
3.17.4	Survival Kit	89
3.18	Handling Provisions	91
3.19	Support Equipment	91
3.20	Pyrotechnics	91
4.0	QUALIFICATION	92
4.1	M.A.C. Qualification	92
4.2	NASA Qualification	92
5.0	TESTING	92
5.1	M.A.C. Testing	92
5.2	NASA Testing	92
6.0	DEFINITIONS	92
APPENDIX		
I-A	Government Furnished Equipment- Contractor Installed	93
APPENDIX		
I-B	Government Furnished Equipment- Government Installed	95

DATE 26 November 1962**MCDONNELL**

ST. LOUIS, MISSOURI

PAGE vi

REVISED _____

REPORT 6603-15A

REVISED _____

~~CONFIDENTIAL~~MODEL Mercury SpacecraftTABLE OF CONTENTS - (Continued)

<u>PARAGRAPH</u>	<u>TITLE</u>	<u>PAGE NO.</u>
APPENDIX		
I-C	Contractor Furnished Equipment- Contractor Installed	96
	Item 1 - General	96
	Item 2 - Rocket Systems	104
	Item 3 - Airborne Equipment	105
	Item 4 - Electrical System	107
	Item 5 - Automatic Stabilization and Control System	117
	Item 6 - Reaction Control System	118
	Item 7 - Communications System	121
	Item 8 - Environmental Control System	124
	Item 9 - Instrumentation System	129
	Item 10 - Landing and Post-Landing Systems	136
	Item 11 - Pyrotechnic System	139

MCDONNELL

ST. LOUIS, MISSOURI

DATE 26 November 1962

REVISED _____

REVISED _____

PAGE viiREPORT 6603-15AMODEL Mercury Spacecraft~~CONFIDENTIAL~~TABLE OF FIGURES

<u>FIGURES</u>	<u>TITLE</u>	<u>PAGE NO.</u>
1	General Arrangement (Illustration)	9
2	Atmospheric Properties (Chart)	16
3	Instrument Panel and Consoles (Illustration)	43
4	3-Axis Hand Controller (Illustration)	44
5	Reaction Control System (Schematic)	55
6	Functional Profile (Block Diagram)	66
7a	DC Power Control System (Schematic)	70
7b	DC Power Control System (Schematic)	71
8a	Instrumentation System (Block Diagram)	82
8b	Special Instrumentation (Block Diagram)	83

MCDONNELL

DATE 26 November 1962

ST. LOUIS, MISSOURI

PAGE 1

REVISED _____

REPORT 6603-15A

REVISED _____

~~CONFIDENTIAL~~

MODEL Mercury Spacecraft

1.0 SCOPE AND CLASSIFICATION

1.1 SCOPE - This configuration specification shall define the details of design, construction, and equipment requirements for a Manned Instrumented Satellite Spacecraft (M.A.C. No. 15A/MA-10) as follows:

NASA Designation Project Mercury

Designer's Name. McDonnell Aircraft Corporation (M.A.C.)

Model Designation. Model 133L

Number and Places for Crew One Cabin Enclosure

Launch Vehicle Atlas D Missile

1.1.1 MISSION - The flight objectives of the Mercury Model 133L Spacecraft and Atlas combination (M.A.C. No. 15A/MA-10) shall be launching of this spacecraft into a manned semipermanent orbit and subsequent safe return to the surface of the earth at a designated time and/or position through use of retrograde thrust and aerodynamic drag. Orbital insertion shall occur at approximately 528,496 international feet altitude (approximately 87 nautical miles) at an inertial velocity of 25,719 feet per second. The elliptical orbit shall have a perigee altitude of not less than 87 nautical miles and an apogee altitude of not greater than 135 nautical miles. Normal duration of the projected mission for the spacecraft described herein shall be a period of one day. The normal point at which re-entry is initiated shall be such that impact occurs in a prescribed area in the Atlantic Ocean. However, in the event of an emergency, it shall be possible for the astronaut to initiate re-entry at any point during an orbital cycle. The re-entry shall be accomplished by application of retrograde thrust to produce a perigee altitude within the atmosphere. The magnitude and direction of retrograde thrust shall be applied so that angles of re-entry into the atmosphere at an altitude of 400,000 feet (approximately 66 nautical miles) will be between 0.734 and 2.31 degrees. The atmospheric forces used in trajectory or other calculations shall be based on the atmospheric density and temperature variations presented in Paragraph 3.2.7 and Figure 2, herein.

1.1.1.1 OBJECTIVES - The test objectives of this mission shall be as follows:

- a. To evaluate the physiological and psychological effects on man subjected to an extended period of weightlessness in a space environment.

~~CONFIDENTIAL~~

DATE 26 November 1962

ST. LOUIS, MISSOURI

PAGE 2

REVISED _____

REPORT 6603-15A

REVISED _____

CONFIDENTIALMODEL Mercury Spacecraft1.1.1.1 OBJECTIVES - (Continued)

- b. To evaluate the performance of man subjected to an extended period of weightlessness in a spacecraft environment.
- c. To verify that man can function as a primary system for extended space flight.
- d. To evaluate the performance of spacecraft systems.
- e. To evaluate the Mercury range network for coverage of missions of at least twenty-four hour duration.

Test program objectives involving this spacecraft shall be the acquirement of data leading up to the primary concern of this research; that of man's ability to adapt to and perform in a space environment and those environments associated with projection into space and subsequent safe return to the earth's surface. The launching site for MA-10 shall be Port Canaveral, Florida.

CONFIDENTIAL

MCDONNELL

DATE 26 November 1962

ST. LOUIS, MISSOURI

PAGE 3

REVISED _____

REPORT 6603-15A

REVISED _____

~~CONFIDENTIAL~~

MODEL Mercury Spacecraft

2.0 APPLICABLE SPECIFICATIONS AND OTHER PUBLICATIONS - McDonnell Aircraft Corporation's prime objective relative to government specifications shall be compliance with applicable documents to the most practicable extent, with the object of providing an optimum operational vehicle within the specified time schedule.

2.1 REFERENCES - The following documents are referenced herein:

M.A.C. Report No. 6495, "Project Mercury Specification Applicability Criteria," dated 4 December 1958, Revised 1 July 1959

M.A.C. Report No. 6693, "Structural Design Criteria for Project Mercury," dated 6 April 1959, Revised 3 August 1960

M.A.C. Report No. 8140, "Contractor Furnished Equipment Status Report," dated 27 March 1961, Revised 1 May 1962

NASA Specification No. S-6, "Specification for Manned Space Capsule," Revised 26 January 1959.

2.1.1 PRECEDENCE - In event of a discrepancy between this document and any document referenced herein, this specification shall take precedence.

2.2 PROCESS SPECIFICATIONS - The following M.A.C. Process Specifications shall apply specifically to the Project Mercury Spacecraft herein:

<u>P.S. No.</u>	<u>TITLE</u>
11051	Cementing of Heat Blankets for Model 133
11224	Sealing of Model 133 Capsule
12301	Cleaning of Model 133 Environmental Control System Lines and Nonoperating Components
12420	Chromic Acid Treatment of Aluminum Tanks for Model 133
13214	Black Oxide Finish for High Emissivity for Model 133
13216	Chemical Oxidation of Beryllium for Model 133
13334	Preparation and Application of Coatings to Interior Surfaces of Sealed Cabin Area of Model 133

~~CONFIDENTIAL~~

MCDONNELL

DATE 26 November 1962

ST. LOUIS, MISSOURI

PAGE 4

REVISED _____

REPORT 6603-15A

REVISED _____

MODEL Mercury Spacecraft~~CONFIDENTIAL~~2.2 PROCESS SPECIFICATIONS - (Continued)P.S. No.TITLE

13430	Exterior Paint Finishing of Model 133 Capsules
14039	Fabrication of Model 133 Tower Insulation
14043	Fabrication of Model 133 Astronaut Seat Assembly
16001.5	Marking of Model 133 Parts and Assemblies
17006	Installation of Teleflex Controls
17046	Care, Handling, Storage and Assembly of Model 133 Glass
17305	Sealing of Printed Wiring for Model 133 Flight Test Instrumentation
17400	Installation of Electrical Wiring in Model 133
17410	Fabrication of Electrical Wire Assemblies for Model 133
17410.1	Assembly of Electrical Cable Terminals and Splices for Model 133
17410.2	Assembly of Electrical Connectors for Model 133
17410.3	Assembly of Radio Frequency Cables for Model 133
20106	Storage and Handling of Silver-Zinc Batteries for Model 133
20113	Care, Handling and Storage of Model 133 Pyrotechnics
20115	Handling, Storage, and Installation of Model 133 Impact Skirt
20151	Storage and Handling of Hydrogen Peroxide (H ₂ O ₂)
20204	Repair for Skin Puncture of Model 133 Capsule Wall
20500	Fabrication and Housekeeping Policies Applicable to Model 133
20501	Requirements for Special Assembly Areas for Model 133
20505	Storage and Handling of Model 133 Environmental Control System
20506	Storage and Handling of Model 133 Reaction Control System
21030	Leak Testing of Model 133 Structural Assemblies

~~CONFIDENTIAL~~

MCDONNELLDATE 26 November 1962

ST. LOUIS, MISSOURI

PAGE 5

REVISED _____

REPORT 6603-15A

REVISED _____

~~CONFIDENTIAL~~MODEL Mercury Spacecraft2.2 PROCESS SPECIFICATIONS - (Continued)P.S. No.TITLE

21311	Incoming Inspection of Model 133 Space Capsule Coatings
22810	Soft Soldering of Electrical Connections for Model 133
23502	Acceptance Procedure for Model 133 Forward Viewing Window Assembly

2.3 CONTRACT CHANGE PROPOSALS - Applicable portions of the following Contract Change Proposals (CCP's) have been incorporated and shall be considered basic to this configuration specification as approved through negotiation with NASA:

CCPTITLE

3	Posigrade Rocket Installation
6	Manual Emergency Controls for Capsule Separation/Escapes Rocket Firing, Escape Tower Jettison, Antenna Jettison, and Emergency Parachute Deployment
41	Installation of Reefed Ring-Sail Landing Parachutes
42	Deletion of Orbit Light
43	Instrumentation Changes; Subcarrier Oscillator and Commutator Replacements
44	Deletion of Requirement for Impact Pressure Measurement
45	Addition of 2-Watt Orbital UHF Transmitter
46-2 Rev. "A"	Provide Supplemental Instrumentation, Telemetry, and Communications Equipment
58-1	Astronaut Emergency Egress Hatch Installation
66	Frequency Changes for Communications Systems
73	Astronaut Observation Window Installation
74	Rescue Aids Switch By-pass Relay and By-pass Switch for 30- Second Retro Firing Delay

~~CONFIDENTIAL~~

MCDONNELLDATE 26 November 1962

ST. LOUIS, MISSOURI

PAGE 6

REVISED _____

REPORT 6603-15A

REVISED _____

~~CONFIDENTIAL~~MODEL Mercury Spacecraft2.3 CONTRACT CHANGE PROPOSALS - (Continued)

<u>CCP</u>	<u>TITLE</u>
76	Main Instrument Panel Redesign
78	Mercury/Atlas Adapter Redesign
82	Capsule Dye Marker Change
90-1	Production Installation of Landing Impact Skirt
91	Elimination of Minitrack/Microlock Beacon
98	Removal of Smoke Recovery Aid
101	Post-Landing Operational Sequence Change for Capsule Instrumentation
106	Provision of Patch Cable - Command Receiver Code Assembly
109	Addition of Astronaut-Operated Switch for Time Zero Relay
113	Escape Tower Modification
130	Provision of "Super SARAH" UHF Rescue Beacon
131	Satellite Clock Change
160	Transducer Replacement
164	Double-Pulse Coding for S-Band Beacon
165	Installation of Whip Antenna
184	Modifications to Mercury Bio-Sensors for Man
189	Manual Hand Controller System, Improvement Changes Thereto
217	Capsule Dye Marker Change
218	Patch Cables for all Command Tone Combinations
226	Incorporation of 5 psi Differential Cabin Pressure Control Valve
228	Double-Pulse Coding for C-Band Beacon

~~CONFIDENTIAL~~

DATE 26 November 1962

MCDONNELL

ST. LOUIS, MISSOURI

PAGE 7

REVISED _____

REPORT 6603-15A

REVISED _____

CONFIDENTIAL

MODEL Mercury Spacecraft

<u>CCP</u>	<u>TITLE</u>
2.3	<u>CONTRACT CHANGE PROPOSALS - (Continued)</u>
239	Triple Nozzle Installation on Jettison Rockets
243	Voltage Regulation for Telemetered Events
251	Improvement of Battery Installation/Removal Time
274	Modify EKG Amplifiers
280	C-Band Beacon Wobulator
287	Disabling the Voice Operated Relay (VOX)
289	Provision of Lockout Feature, C-Band Beacon Modification
299	H ₂ O ₂ Pressure Gauge Installation
300 Rev. "A"	Astronaut Blood Pressure Device
304	S-Band Radar Beacon Frequency Change
309	ECS Spring-Loaded Inlet Check Valve
313	Additional Instrumentation for Capsules 10 and 16 thru 20
322	Provision of Lockout Feature, S-Band Beacon Modification
329	Snorkel Inflow Valve By-pass Switch and Blow-off Door Interlock
336	Oxygen Bottle Nomenclature Change
340	One-Day Mission Spacecraft
342	Mercury Commutator Replacement
343	Telemetry Transmitter Replacement
344	Cable Retention System Improvements

CONFIDENTIAL

MCDONNELLDATE 26 November 1962

ST. LOUIS, MISSOURI

PAGE 8

REVISED _____

REPORT 6603-15A

REVISED _____

~~CONFIDENTIAL~~MODEL Mercury Spacecraft

2.4 REQUEST FOR ALTERATION.- The following requests for alteration (RFA) recommended during Development Engineering Inspection (DEI) No. 5, 6-7 June 1962, have been incorporated on Spacecraft No. 15A. RFA's incorporated pursuant to DEI's No. 1 through 4 are not listed due to complete closeout of these RFA's by the customer and contractor.

<u>RFA NO.</u>	<u>TITLE</u>
5-3	RCS Heat Stabilization
5-4	Inverter Cooling
5-5	"D" Package VCO Mounting Insert
5-7	VCO's, Transmitters, and Commutators: Temperature and Vibration Tests
5-11	ECS Temperature Indication
5-13	Blood Pressure Measuring System - Controller Relocation
5-17	ECS Lines Change
5-18	Study Umbilical Door and Latching Mechanism
5-19	S- and C- Band Coaxial Cables
5-20	Redesign Water Control Valve Handles
5-21	Modify 45-72707-5 Explosive Cell
5-23	Label Altitudes on Cabin Pressure Gauge
5-24	Gage Readability
5-25	Pointer Addition
5-26	Fuse Switch Marking
5-29	M.A.C. to Study Possibility of Having Reserve H ₂ O ₂ Supply

DATE 26 NOVEMBER 1962

REVISED _____

REVISED _____

MCDONNELL

ST. LOUIS, MISSOURI

PAGE 9

REPORT 6603-15A

MODEL MERCURY SPACECRAFT

~~CONFIDENTIAL~~

GENERAL ARRANGEMENT (MERCURY SPACECRAFT-ATLAS ADAPTER)

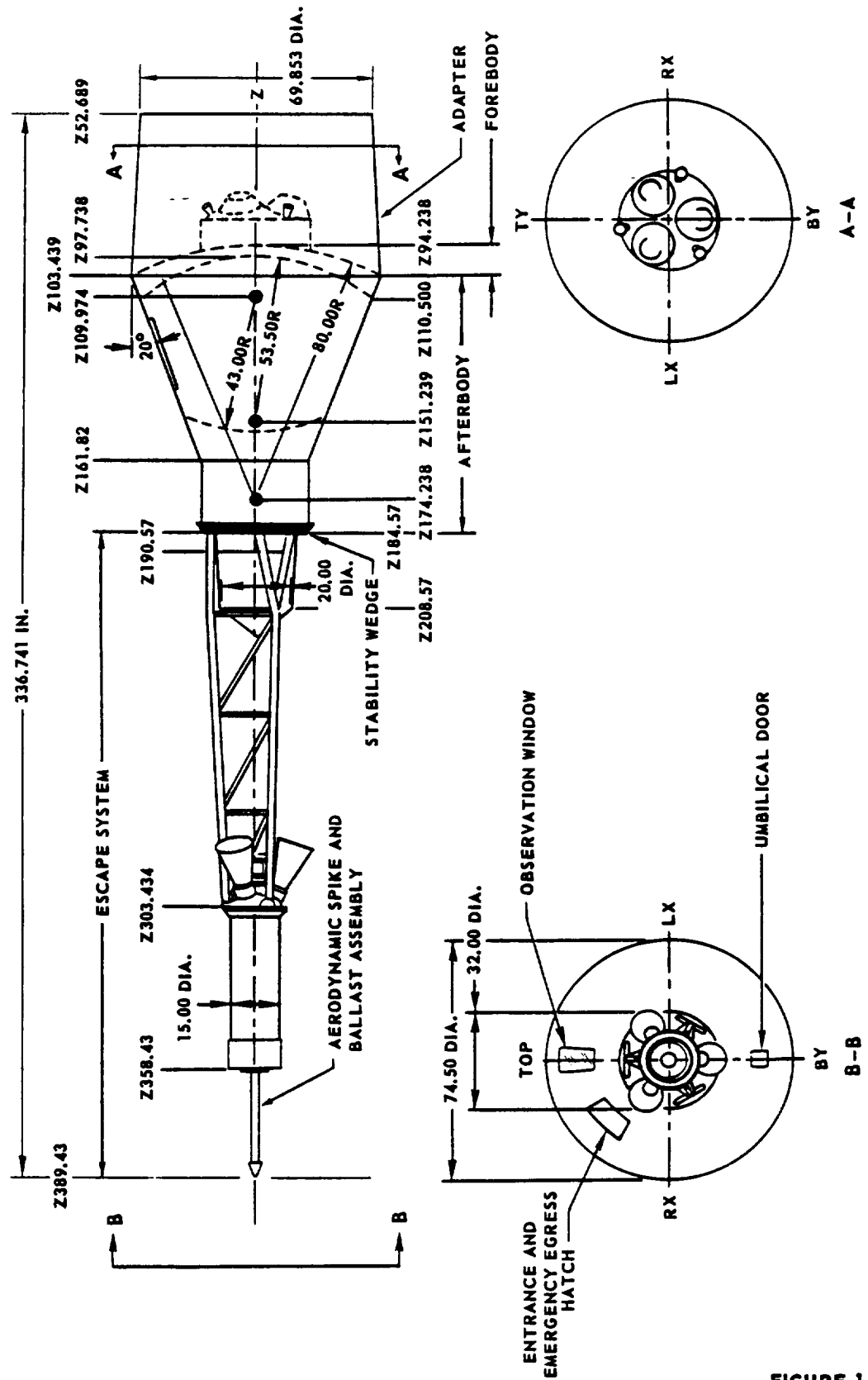


FIGURE 1

~~CONFIDENTIAL~~

DATE 26 November 1962

MCDONNELL

ST. LOUIS, MISSOURI

PAGE 10

REVISED _____

REPORT 6603-15A

REVISED _____

CONFIDENTIAL

MODEL Mercury Spacecraft

3.0 REQUIREMENTS

3.1 CHARACTERISTICS

3.1.1 WEIGHT AND BALANCE - Specification MIL-W-25140 and Technical Order 1-1B-40 shall be utilized as reference guides.

3.1.1.1 GROSS WEIGHT - Current weight breakdown and center of gravity (CG) of the spacecraft as described herein are included. The actual weight and balance data will be supplied when available.

3.1.1.2 LAUNCH WEIGHT - The launch weight of the Mercury Spacecraft No. 15A shall be defined as the basic spacecraft and equipment, pertinent to the mission to be performed, plus the adapter, escape tower assembly, retrograde rocket assembly, hydrogen peroxide (H_2O_2), and posigrade fuel.

3.1.1.3 ORBIT WEIGHT - Orbit weight is defined as the weight of the spacecraft when projected into orbit.

3.1.1.4 RE-ENTRY WEIGHT - Re-entry weight is defined as the orbit weight, less H_2O_2 and water used during the orbit period and during re-entry initiation, and less the retrograde rocket assembly.

3.1.1.5 ABORT WEIGHT - Abort weight is defined as the orbit weight of the spacecraft less the retrograde rocket assembly plus the escape system.

3.1.1.6 IMPACT WEIGHT - Impact weight is defined as the re-entry weight, less the drogue and main parachutes, antenna assembly, and less any ablated material, H_2O_2 and water used and jettisoned during re-entry.

CONFIDENTIAL

MCDONNELLDATE 26 November 1962

ST. LOUIS, MISSOURI

PAGE 11

REVISED _____

REPORT 6603-15A

REVISED _____

~~CONFIDENTIAL~~MODEL Mercury Spacecraft

A

3.1.1.7 WEIGHT AND BALANCE SUMMARY

a. Vehicle Weight Breakdown

<u>ITEM</u>	<u>WEIGHT</u>
Structure	613.22
Adapter - Spacecraft to Booster (Incl. Clamp Ring)	191.31
Escape System	1100.66
Heat Shield-Ablation	315.27
Stabilization/Control System	311.55
Retrograde System	295.79
Landing System	320.43
Instruments and Navigation Equipment	77.84
Electrical Group	369.85
Communications	119.54
Environmental Control System	190.02
Telemetry and Recording	115.01
Recovery Gear	25.44
Crew and Survival Equipment	243.13
Ballast - Flotation	11.03
Manufacturing Variations	1.68
Gross Weight Launch Vehicle	4301.77

MCDONNELLDATE 26 November 1962

ST. LOUIS, MISSOURI

PAGE 12

REVISED _____

REPORT 6603-15A

REVISED _____

~~CONFIDENTIAL~~MODEL Mercury Spacecraft

A

3.1.1.7 WEIGHT AND BALANCE SUMMARY - (Continued)

b. Normal Mission

<u>ITEM</u>	<u>WEIGHT</u>	<u>CG* LOCATION</u>
Gross Weight Launch Vehicle	4301.77	168.06
Less: Escape Tower (W_j)	1100.66	
Add: $.2W_j$	220.13	
Effective Launch Weight	3421.24	
Less: $.2W_j$	220.13	
Gross Weight - Tower Separated	3201.11	118.61
Less: Adapter and Clamp Ring	191.31	
Posigrade Fuel	-6.24	
Orbit Weight	3003.56	120.83
Less: H_2O_2 - Orbit and Orient	-37.40	
Coolant Water & Oxygen	-43.30	
Retrograde Weight	2922.86	121.22
Less: Retrograde Fuel and Covers	-146.91	
H_2O_2 - Retrograde Hold	-5.00	
Retrograde Fired Weight	2770.95	122.98
Less: Retrograde Package	119.22	
Re-Entry Weight	2651.73	124.60
Less: H_2O_2 - Re-Entry Hold	-5.00	
Coolant Water - Re-Entry	-.71	
Ablated Material - Nominal	-10.00	
End of Re-Entry Weight	2636.02	124.74
Less: H_2O_2 - Drogue to 10,000 feet	-8.00	
Antenna Assembly	-87.54	
(Horizon Scanners)		
(Drogue Chute)		

* CG location is given as Z station. Theoretical edge of heat shield is Z = 103.44 (a point on a 37.25-inch circular radius formed by the intersection of the heat shield 80.00 inch spherical radius and the projection of the spacecraft conical surface.)

~~CONFIDENTIAL~~

MCDONNELLDATE 26 November 1962

ST. LOUIS, MISSOURI

PAGE 13

REVISED _____

REPORT 6603-15A

REVISED _____

~~CONFIDENTIAL~~MODEL Mercury Spacecraft

A

3.1.1.7 WEIGHT AND BALANCE SUMMARY - (Continued)

<u>ITEM</u>	<u>WEIGHT</u>	<u>CG* LOCATION</u>
Main Chute Deployment Weight	2540.48	122.30
Less: Main Chute	69.54	
H ₂ O ₂ Jettisoned	-15.00	
Impact Weight	2455.94	121.06
Extend Whip Antenna	0.00	
Less: Reserve and Pilot Chutes	-69.59	
Dye Marker	-2.75	
Flotation Weight	2383.60	119.60
c. Abort Condition		
Gross Weight Launch Vehicle	4301.77	168.06
Less: Adapter and Clamp Ring	-191.31	
Retrograde/Posigrade Assy.	-272.37	
Abort Weight	3838.09	177.90
Less: Escape Rocket Propellant	-293.20	
Abort Weight - Less Escape Fuel	3544.89	165.59
Less: Escape Tower	-807.46	
Re-Entry Weight - Abort Condition	2737.43	124.04
Less: H ₂ O ₂ Orient	-1.00	
Antenna Assembly	-87.54	
Main Chute Deployment Weight - Abort	2648.89	121.62

* CG location is given as Z station. Theoretical edge of heat shield is Z = 103.44 (a point on a 37.25-inch circular radius formed by the intersection of the heat shield 80.00 inch spherical radius and the projection of the spacecraft conical surface.)

~~CONFIDENTIAL~~

DATE 26 November 1962

ST. LOUIS, MISSOURI

PAGE 14

REVISED _____

REPORT 6603-15A

REVISED _____

~~CONFIDENTIAL~~MODEL Mercury Spacecraft

3.2 GENERAL DESCRIPTION

3.2.1 CONFIGURATION - The spacecraft configuration shall be of the type shown in Figure 1 and shall fulfill the requirements specified herein. The complete spacecraft shall be comprised of the following:

- a. Structure (See Paragraph 3.4)
- b. Heat and Micrometeorite Protection (See Paragraph 3.6)
- c. Booster Adapter and Separation System (See Paragraph 3.7)
- d. Crew Station (See Paragraph 3.8)
- e. Consoles and Controls (See Paragraph 3.8.8)
- f. Instrumentation and Display (See Paragraph 3.8.9)
- g. Environmental Control System (See Paragraph 3.9)
- h. Stabilization/Control Subsystem (See Paragraph 3.10)
- i. Reaction Control System (See Paragraph 3.10.3)
- j. Retrograde Rocket System (See Paragraph 3.11)
- k. Posigrade Rocket System (See Paragraph 3.11.4)
- l. Escape System (See Paragraph 3.12)
- m. Power Supplies (See Paragraph 3.13)
- n. Communication Equipment (See Paragraph 3.14)
- o. Recording Equipment (See Paragraph 3.15)
- p. Navigational Aids (See Paragraph 3.16)
- q. Landing, Post-Landing and Survival Systems (See Paragraph 3.17)
- r. Handling Provisions (See Paragraph 3.18)
- s. Pyrotechnics (See Paragraph 3.20)

~~CONFIDENTIAL~~

DATE 26 November 1962**MCDONNELL**

ST. LOUIS, MISSOURI

PAGE

15

REVISED _____

REPORT 6603-15A

REVISED _____

~~CONFIDENTIAL~~MODEL Mercury Spacecraft

3.2.2 SELECTION OF MATERIALS - Mission requirements of the spacecraft dictate use of high-temperature-resistant materials. Heat resisting materials such as titanium, beryllium, steel, nickel-base alloy (Rene' 41), and insulation materials such as Thermoflex, fiberglass and ceramic coatings shall be used. Where practicable, materials in accordance with the requirements of ANA bulletins 143d and 147r shall be utilized.

3.2.3 FABRICATION - Structural design concepts of the spacecraft emphasize employment of proven manufacturing techniques and methods to the greatest possible extent. Maximum use shall be made of developed "off-the-shelf" components fabricated by dependable subsystem manufacturers. McDonnell Aircraft Corporation standards of workmanship, processes and procedures are based on fabrication of production articles according to military standards.

3.2.4 INTERCHANGEABILITY AND REPLACEABILITY - The interchangeability and replaceability intent of Specification MIL-I-8500A (ASG) shall be met on those items of equipment possessing identical physical characteristics and functions in relation to spacecraft usage as defined in M.A.C. Report No. 6495, revised 1 July 1959. Interchangeability and replaceability requirements are not considered mandatory on basic spacecraft structure. Interchangeability and replaceability for those equipment items as set forth in this paragraph shall be assured by design requirements, nature of manufacture and monitoring by contractor personnel, and need not be physically demonstrated by the exchange or removal of equipment items from the capsule and replacement of these items in a formal demonstration.

3.2.5 FINISH - Finish requirements shall be as specified in the Finish Specification, Drawing No. 45-90000.

3.2.6 IDENTIFICATION AND MARKING - MIL-STD-130 shall be considered as a reference guide in identification of the spacecraft and spacecraft components. Marking shall be in accordance with Specification MIL-M-25047 as applicable. Drawing No. 45-00008 shall define external spacecraft color requirements and shall specify that the United States flag and the words "UNITED STATES" in 6-inch block letters shall be painted on opposite sides of the spacecraft. Spacecraft test cable plug or receptacle identification shall be in accordance with Drawing No. 45-00010. Spacecraft instrument range marking shall be in accordance with Drawing No. 45-00011.

3.2.7 EXTREME ENVIRONMENTAL REQUIREMENTS - Trajectory characteristics shall be based on the atmospheric density and temperature variations of ARDC 1959 model atmosphere. Earlier data, as presented in Figure 2, may be used when its use is not critical or when it is compatible with ARDC 1959 model atmosphere. The spacecraft, all subsystems, and components shall be designed to withstand the environmental conditions which are expected to be encountered during the mission outlined in Paragraph 1.1.1.

~~CONFIDENTIAL~~

MCDONNELL

ST. LOUIS, MISSOURI

DATE 26 NOVEMBER 1962

REVISED

REVISED

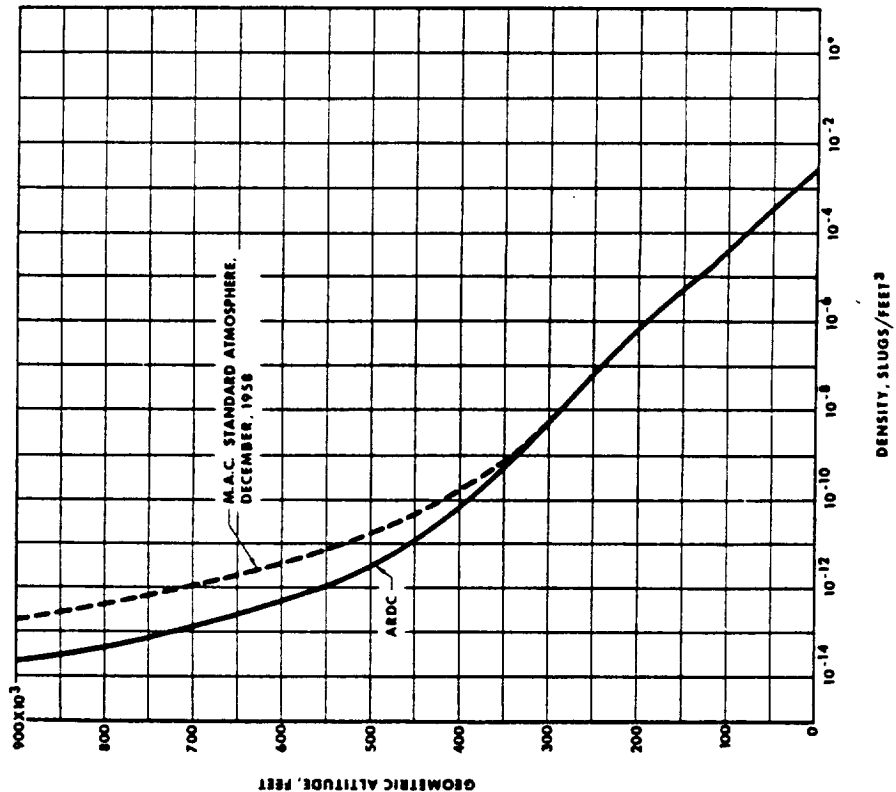
PAGE 16

REPORT 6603-15A

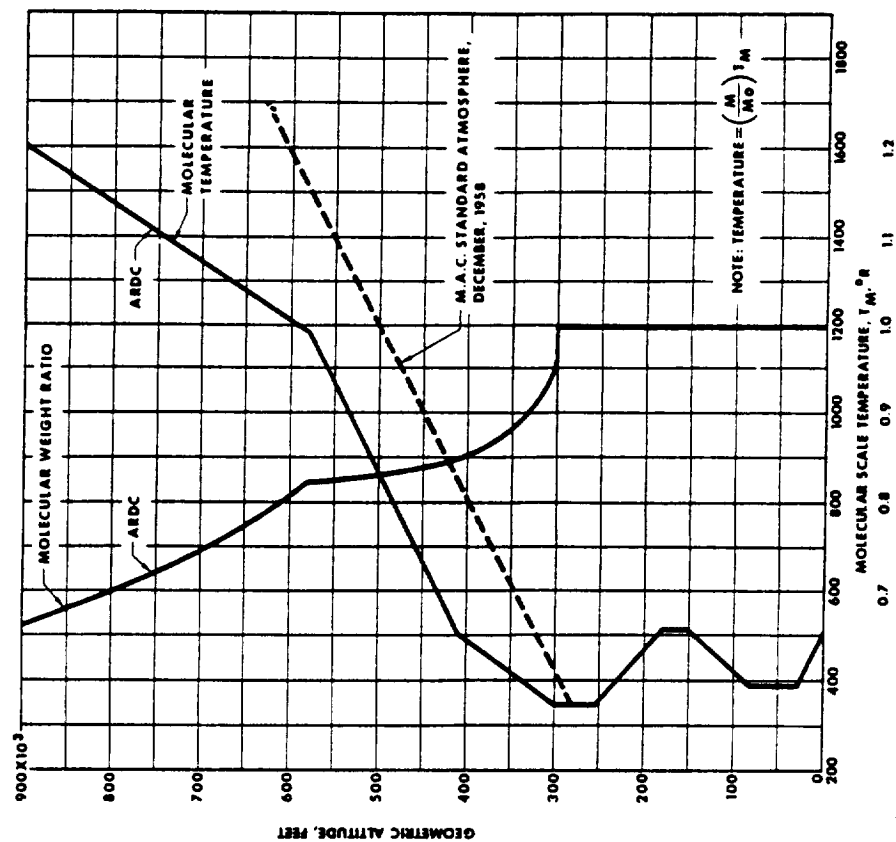
MODEL MERCURY SPACECRAFT

CONFIDENTIAL

ATMOSPHERIC PROPERTIES



(A) ATMOSPHERIC DENSITY VERSUS GEOMETRIC ALTITUDE



(B) MOLECULAR TEMPERATURE AND MOLECULAR WEIGHT RATIO VERSUS GEOMETRIC ALTITUDE

FIGURE 2

CONFIDENTIAL

MCDONNELL

DATE 26 November 1962

ST. LOUIS, MISSOURI

PAGE

17

REVISED _____

REPORT

6603-15A

REVISED _____

~~CONFIDENTIAL~~

MODEL Mercury Spacecraft

3.2.8 LUBRICATION - Lubrication of components where required shall be in accordance with the requirements of Specification MIL-L-6880B. Lubrication data shall be included in maintenance handbooks. No petroleum-base lubricants shall be used. Lubricants shall be of the silicone base, fluorolube, oxylube 702, and dry film type. Lubrication shall not cause any toxic or flammable substances to occur in the astronaut's compartment or in the environmental control system.

3.2.9 RELIABILITY - An integrated reliability program shall be conducted throughout the design, development and fabrication of the Mercury spacecraft. This shall include the salient features outlined in Specification MIL-W-9411 to the most practicable extent within the scope of the program. The design approach shall emphasize the safety of the mission. Although not specified herein in every instance, due consideration shall be given to simplicity, redundancy, and the use of back-up systems in order to improve mission reliability.

DATE 26 November 1962

ST. LOUIS, MISSOURI

PAGE 18

REVISED _____

REPORT 6603-15A

REVISED _____

~~CONFIDENTIAL~~MODEL Mercury Spacecraft

3.3 AERODYNAMIC AND HYDRODYNAMIC CONSIDERATIONS - The design configuration of the spacecraft described herein relative to aerodynamic and hydrodynamic considerations shall be based on the following:

- a. Supersonic launch and escape drag shall be reduced by use of an aerodynamic spike and ballast assembly located on top of the escape rocket structural assembly.
- b. The over-all spacecraft configuration at the time of re-entry shall be statically stable in the heat-shield-forward attitude.
- c. Correct attitude during the re-entry phase shall be facilitated by use of a destabilizer flap located on the top of the antenna assembly opposite the roll-axis horizon scanner.
- d. Re-entry forebody shape effect on water and land impact loads.
- e. Design landing condition of the spacecraft has been based on impacts on both water and land within the structural design parameters defined in M.A.C. Report No. 6693, revised 3 August 1960.
- f. The spacecraft shall be buoyant and hydrodynamically stable upright in the water, impact skirt and heat shield assembly down, and shall be capable of righting itself.

3.4 STRUCTURAL DESIGN CRITERIA - Structural design criteria of the Mercury spacecraft shall be as defined in M.A.C. Report 6693, revised 3 August 1960, and Paragraphs 2.4 through 2.4.2.4 of NASA Specification S-6, revised 26 January 1959.

DATE 26 November 1962**MCDONNELL**

ST. LOUIS, MISSOURI

PAGE 19

REVISED _____

REPORT 6603-15A

REVISED _____

~~CONFIDENTIAL~~MODEL Mercury Spacecraft

3.5 SPACECRAFT

3.5.1 DESCRIPTION - The Model 133L Spacecraft shall be of semi-conical configuration, incorporating a blunt forebody designed to mate the booster adapter and support the retrograde rocket package (see Figure 1, Page 9). The convex contour of the forebody shall provide maximum practical wave drag and uniform heating consistent with other requirements. The afterbody shall consist of a truncated conical section surmounted (in launch attitude) by a short cylindrical section which shall support the communications antenna assembly and escape system and house the landing parachutes. The conical section shall incorporate the pressurized crew compartment, entrance and emergency egress hatch, astronaut observation window, and umbilical door, and include provisions for booster adapter clamp ring engagement and cylindrical section and heat shield attachment. The over-all afterbody configuration shall augment stability, provide adequate volume for crew station and equipment installation and minimize aerodynamic heating. Internal volume of the capsule shall be based on physical dimensions of a human occupant 5 feet 10-1/2 inches tall, weighing 180 pounds.

3.5.2 CONSTRUCTION - The spacecraft shall be of semimonocoque construction consisting of a conical and a cylindrical section. The conical section shall consist of an unbeaded inner skin which shall be seam welded to a beaded outer skin with 24 equally spaced longitudinal stringers. Two bulkheads and the skin assembly shall form the pressurized cabin area. The cylindrical section incorporates a single skin with 12 equally spaced stringers and internal shear webs which distribute parachute deployment and suspension loads. The spacecraft substructure shall be protected from heat, noise, and micrometeorites by insulation, an outer covering of shingles, and a fiberglass heat shield, which shall ablate during re-entry.

3.5.3 ENTRANCE AND EMERGENCY EGRESS HATCH - The entrance and emergency egress hatch (Drawing No. 45-35003), located in the spacecraft conical section, shall be trapezoidal in shape as dictated by the spacecraft configuration (see Figure 1). The hatch assembly shall be of construction similar to the basic spacecraft structure, designed to permit entry into, and emergency egress from, the spacecraft. An explosive assembly (Drawing No. 45-35701) shall be incorporated in the hatch assembly to serve as a means, when ignited, of breaking the 70 hatch attachment bolts. The explosive assembly shall be mounted about the hatch perimeter and shall consist of a gasket type sill containing a continuous single strand of explosive charge to effect severance of the attachment bolts. The strand shall be ignited from both ends simultaneously to provide redundancy. A push-button initiator, located on the hatch interior to the astronaut's upper right, shall, after removal of a safety cap and pin, ignite the explosive charge when pushed by the astronaut. A pull initiator assembly shall be provided for ground rescue utilization on the exterior of the hatch beneath the shingles. Function of the pull initiator assembly shall be the same

~~CONFIDENTIAL~~

DATE 26 November 1962**MCDONNELL**

ST. LOUIS, MISSOURI

PAGE 20

REVISED _____

REPORT 6603-15A

REVISED _____

~~CONFIDENTIAL~~MODEL Mercury Spacecraft

3.5.3 ENTRANCE AND EMERGENCY EGRESS HATCH - (Continued)

as for the astronaut-actuated initiator. The hatch assembly shall be secured to the spacecraft structure by two wire springs (Drawing No. 45-35058). These springs shall absorb the energy expended by the explosive charge and serve to prevent injury to personnel working in the hatch area during recovery operations. A cabin pressurization fitting assembly shall be located at approximately Z123.00 between stringers six and seven. This assembly shall provide the necessary inlet and outlet ports for a ground leakage check of the hatch seal prior to launch. Spacecraft cabin leakage rate shall not exceed 600 cc per minute. Upon completion of the leakage check, the ports shall be sealed.

3.5.4 EXIT HATCH - The exit hatch (Drawing No. 45-32023) shall be located in the small afterbody pressure bulkhead. The hatch shall be dish-shaped and shall be an inward-opening, plug-type hatch of reinforced aluminum construction. The hatch shall be held in place by a retaining ring which, when latched in place, shall cause the hatch to seal to the small pressure bulkhead. The retaining ring shall consist of a partial ring so that as the latch handle is actuated to the closed position, the ring is expanded to form a tight seal. As the latching handle linkage is moved to the open position, the expansive force shall be released. In order to facilitate egress through the exit hatch, the right section of the instrument panel shall be designed for removal. The exit hatch shall remain operable after a normal land impact.

3.5.5 WINDOW AND FILTER

3.5.5.1 WINDOW - An observation window assembly shall be provided for astronaut visual observation of the space environment. This assembly shall be located in the afterbody conical section forward of and above the astronaut's head from Stations Z124.81 to Z144.80. The window assembly shall consist of an outer window assembly (Drawing No. 45-35030) and an inner window assembly (Drawing No. 45-35035). Window shape shall be trapezoidal as dictated by the spacecraft conical configuration with the base of the trapezoid toward the heat shield end as indicated in Figure 1 herein. The outer window assembly shall consist of a single pane of 0.350 inch Vycor glass contoured to the spacecraft structural curvature. The outer pane shall possess grade 2N optical fidelity in its two critical areas. Grade 2N glass shall permit an optical deviation of two minutes of arc. Location of critical areas shall be such as to be compatible with reference sight lines on the inner window assembly. The outer pane shall be mounted in a structural frame with suitable sealing gaskets on the inner and outer surfaces and with spacers supporting the edge inside the frame. The inner window assembly shall consist of three flat panes of glass of the trapezoid configuration and each pane shall have an optical fidelity of Grade 2N.

~~CONFIDENTIAL~~

DATE 26 November 1962

ST. LOUIS, MISSOURI

PAGE 21

REVISED _____

REPORT 6603-15A

REVISED _____

CONFIDENTIALMODEL Mercury Spacecraft**3.5.5.1 WINDOW - (Continued)**

The two inner panes shall be 0.340-inch tempered glass and the outermost pane of the inner window assembly shall be 0.170-inch Vycor glass. The outermost pane shall contain lateral reference sight lines on the inner and outer surfaces as required by the window mounting angle and the fixed optical reference point. The set of lines near the base of the trapezoidal pane shall provide an eye level sight reference for viewing the horizon compatible with a spacecraft attitude of 34 degrees with heat shield up. The second set of lines shall provide an eye level reference for viewing the horizon compatible with a spacecraft attitude of 14.5 degrees from horizontal with heat shield up. The inner window panes shall be mounted in individual supporting rings, independently sealed by gaskets on upper and lower surfaces, and held firm by spacers around the edge inside the ring. The outer pane of the inner window assembly shall be capable of withstanding the environmental conditions normally encountered by the outer window assembly. The pane assemblies shall be supported by a structural frame which shall be attached and sealed to the spacecraft inner structure. The inner surface of the outer window pane and both surfaces of the inner window assembly panes shall be coated with a single layer of magnesium fluoride (MgF_2) film for impeding thermal radiation into the cabin. Provisions shall be incorporated for reduction of glare from the window supporting structure and adjacent areas. Mounting provisions for the utility camera shall be incorporated at the upper right-hand corner of the inner window frame (see Paragraph 3.15.1).

3.5.5.2 FILTER - A filter assembly (Drawing No. 45-86005) shall be provided for the observation window and shall be mounted on the inner window assembly (see Paragraph 3.5.5.1). The filter assembly shall consist of a plexiglas panel, hinged along the center and at one end. The plexiglas panel shall be 0.080 inch thick and configured to the shape of the window assembly. A brush sealing strip shall be attached along the panel lower edge to allow equipment clearance when the filter is opened and closed. The filter shall be retained in the closed position by a spring-loaded latch located on the outer edge of the plexiglas panel. To place the filter in the open position, the astronaut shall disengage the latch at the outer edge of the panel, fold the filter along its center hinge and place it against the spacecraft, where it shall be retained in the open position by a spring-loaded latch attached to the side of the spacecraft. The filter plexiglas panels shall be red in color to afford the astronaut a means of adapting from a day to night environment. The filter panels shall possess optical quality equal or superior to Plex II in accordance with Specification MIL-P-5425B, Finish A, except for the light transmissibility characteristics required for filtering capabilities. An extended view mirror assembly shall be provided.

DATE 26 November 1962**MCDONNELL**

ST. LOUIS, MISSOURI

PAGE 22

REVISED _____

REPORT 6603-15A

REVISED _____

~~CONFIDENTIAL~~MODEL Mercury Spacecraft

3.5.5.2 FILTER - (Continued)

The mirror assembly shall be located on the lower end of the inner window assembly and shall mate with the filter assembly sealing strips. The mirror shall be of aluminum-alloy construction with a reflecting surface which shall permit a maximum image shift approximating 0.09 inch at 25 feet when viewed at 18 inches. The mirror assembly shall incorporate a ring-type handle to facilitate positioning when an extended view of the horizon is desired. This assembly may be locked in either of two positions by means of a spring-detent mechanism. The filter assembly shall be accessible to the astronaut while in the restrained condition.

3.5.6 ANTENNA ASSEMBLY - A communications antenna (Drawing No. 45-31003) shall be installed between the cylindrical recovery compartment and the escape tower, and shall extend from Station 2184.57 to 2208.57. The antenna assembly shall house the pitch and roll horizon scanners and the drogue parachute. An eight-inch window assembly (Drawing No. 45-31016) shall be located around the outer base of the antenna assembly and shall act as a dielectric for the main bicone antenna. A destabilizer flap assembly (Drawing No. 45-31026) shall be hinged to the upper extremity and outer edge of the antenna structural assembly opposite the roll horizon scanner, and shall prevent the spacecraft from becoming stable with the antenna assembly forward. The destabilizer flap and horizon scanner cover (see Paragraph 3.10.2) shall be combined into a single structural unit, spring-loaded to the outboard position and tethered to the antenna assembly by a nylon cord. At tower jettison, nylon lanyards attached to the tower structure shall actuate two 4-second time-delay reefing cutters, which shall sever the tie-down cord and release the destabilizer flap/scanner cover assembly for erection to its functional position. The antenna assembly shall be automatically jettisoned from the spacecraft as the spacecraft descends to 10,000 feet altitude. (See Paragraph 3.17.1.2.)

3.5.7 ANTENNA COVER - An antenna cover assembly (Drawing No. 45-31036) shall be incorporated in the escape tower structural assembly. The cover assembly shall shield the antenna assembly and horizon scanners during the launch phase. The cover assembly, being an integral part of the tower, shall permit horizon scanning following tower separation.

3.5.8 UMBILICAL DOOR - The umbilical connection receptacle (see Paragraph 3.13.4.1) shall be protected after umbilical separation by a retractable door of cobalt alloy and high temperature steel construction. The retracting mechanism shall be spring-loaded in the closed position, providing automatic closure of the door at umbilical separation. Visual indication of door closure shall be provided on the left-hand console (see Paragraph 3.8.9.5).

3.6 HEAT AND MICROMETEORITE SHIELDING

3.6.1 FOREBODY HEAT PROTECTION - The spacecraft shall be protected by a dish-shaped ablative type heat shield which shall form the forward surface (forebody) of the spacecraft. The heat shield (Drawing No. 45-32052) shall be designed to ablate during re-entry and shall be constructed of fiberglass shingles laminated to form a smooth contour in its final size of 74.44 inches diameter with a spherical radius of 80 inches. Design consideration shall be given to landing loads on the heat shield to insure that the pressure vessel is not punctured on water landings and that internal equipment is not damaged upon land impact. The heat shield shall be designed for retention on the spacecraft until actuation of the impact bag extend valve and the heat shield release mechanism (Drawing No. 45-32301). The heat shield shall be attached to the spacecraft conical structure assembly (afterbody) by a titanium heat shield attach ring. The attach ring riveted to the spacecraft structure assembly shall contain 48 elongated holes (to allow for thermal expansion) to mate with bolt holes spaced about the rim of the heat shield. There shall be 24 locking studs alternated with 22 guide studs and two holes remaining unused beneath the release mechanism actuators. Actuation of the heat shield release mechanism shall initiate withdrawal of U-shaped lugs, releasing the 24 lock studs and the heat shield from the spacecraft structure assembly.

3.6.2 AFTERBODY HEAT PROTECTION - Afterbody heat protection shall consist of shielding on the outside surface with insulation between the shielding and the primary structure. The shielding shall be shingles of 0.016 inch thick Rene' 41 on the conical section and antenna assembly and 0.220 inch thick beryllium on the cylindrical section. Both the Rene' 41 and beryllium shingles shall be installed to allow thermal expansion while remaining within acceptable flutter limits. The insulation between the shielding and the primary structure shall minimize thermal leakage and serve to attenuate the external noise reaching the spacecraft interior.

3.6.3 MICROMETEORITE PROTECTION - Protection of the underlying pressure vessel and recovery compartment against impacts from micrometeorites shall be provided by the outer shielding skin specified above.

MCDONNELL

DATE 26 November 1962

ST. LOUIS, MISSOURI

PAGE

24

REVISED

REPORT

6603-15A

REVISED

~~CONFIDENTIAL~~

MODEL

Mercury Spacecraft

3.7 BOOSTER ADAPTER - M.A.C. shall be responsible for matching the Mercury spacecraft to an Atlas D booster, the Mercury launch vehicle (HS-36). The spacecraft shall replace the booster nose cone in a manner which requires a minimum of modification to the booster system. The adapter (Drawing No. 45-33002) shall be of conventional semimonocoque aluminum, steel, and titanium construction. The adapter shall consist of a machined structural frame utilizing a spacecraft match ring and a booster mating ring, with titanium sheet metal skin reinforced by longitudinal hat sections spaced about the outer surface. The adapter shall have ventilation provisions for launch vehicle LOX environmental relief and pressure equalization during launch. An access door shall be provided between the intermediate rings diametrically opposite the LOX valve openings for access to the booster nose and the spacecraft heat shield area while on the launch pad. The adapter shall be attached to the spacecraft by a clamp ring installation (Drawing No. 45-72100). The clamp ring installation shall consist of three segmented sections joined by three explosive tension bolts. Two explosive bolts can be initiated electrically from either end by a dual electrical system. The third explosive bolt may be electrically initiated from one end. An initiator system shall supply a compressed gas to the opposite end for initiating a percussion cap. Automatic spacecraft-adapter separation circuitry shall be activated by placing the SQUIB ARM switch on the main instrument panel in the ARM position prior to launch. Upon sustainer engine thrust decay to 0.20g as sensed by the spacecraft-contained cutoff sensor, the 0.20g contacts shall close, energizing the spacecraft-adapter clamp ring bolts power relay, which shall initiate detonation of the explosive bolts. Separation of the clamp ring bolts shall close the spacecraft-adapter ring separation limit switches. This action shall initiate a firing signal to the posigrade rockets (see Paragraph 3.11.4). In event the automatic system does not function, as indicated by the telelight sequence system (see Paragraph 3.8.9.4), the override control may be used. This override control shall consist of a pull ring which must be actuated by the astronaut. Pulling the ring shall actuate a limit switch which shall energize a redundant electrical system for detonation of two of the explosive bolts and shall actuate an initiator for firing the third explosive bolt. Detonation of any one explosive bolt shall separate the clamp ring. Spacecraft-adapter separation may be initiated by ground command (G-1 on the Functional Profile, Figure 6, Page 66) through abort circuitry.

~~CONFIDENTIAL~~

DATE 26 November 1962

ST. LOUIS, MISSOURI

PAGE 25

REVISED _____

REPORT 6603-15A

REVISED _____

MODEL Mercury Spacecraft~~CONFIDENTIAL~~

3.8 CREW STATION - The location and actuation of all astronaut operated controls, and the arrangement of instruments and warning devices shall be in accordance with good human engineering practice. Restrictions imposed on the astronaut by the restraint system, pressure suit and acceleration forces shall be considered in crew station design.

3.8.1 ASTRONAUT SUPPORT COUCH - Each astronaut shall be provided with an individually-molded support couch consisting of a contoured seat assembly (Drawing No. 45-82000). Seat assemblies shall be shipped from the contractor's plant to the launch site for installation. The seat assembly shall support the astronaut's torso, arms to a point just below his elbows, and head. Left and right-hand arm rests shall be provided with the seat installation. Each seat shall be fabricated in accordance with M.A.C. Process Specification 14043.

3.8.1.1 CONSTRUCTION - Seat construction primarily shall be of glass-fiber plastic laminate in accordance with M.A.C. Material Specification MMS-501, aluminum-alloy honeycomb core in accordance with M.A.C. Material Specification MMS-701, glass-fabric laminate, aluminum-alloy, plastics, fiberglass and lockfoam filler. Each seat assembly shall consist of an inner liner and outer shell assembly with the area between filled with lockfoam plastic. The inner liner shall be of glass-fiber plastic laminate and glass-fabric laminate molded to the astronaut's body as specified in the preceding paragraph. The outer shell shall be constructed of laminate-skin, honeycomb-core sandwiches formed to the curvature of the large pressure bulkhead on the back, to the contour of the inner liner on the bottom, roughly to the astronaut's helmet and shoulders on the head assembly, and to the vertical seat support beam assemblies to the left and right of center. The sandwiches shall be joined by formed laminate skin, plastic compound filled angles, and aluminum-alloy rub strips. A glass-fiber plastic laminate support fitting shall be provided on each side of the seat assembly.

Loads from the astronaut shall be transmitted through the inner liners which shall act as distribution panels to the honeycomb structure. Crushable support assemblies constructed of aluminum-alloy honeycomb glass-fiber laminate shall be installed between the large pressure bulkhead and the seat assembly. The honeycomb-core construction employed in the seat support assemblies shall decrease the loading on the astronaut due to excessive positive transverse accelerations and provide adequate protection against physiological damage and loss of consciousness when subjected to peak positive accelerations as dictated by the mission defined in Paragraph 1.1.1 herein. The seat design shall be such as to provide adequate support under conditions of lateral acceleration.

3.8.2 ASTRONAUT RESTRAINT SYSTEM - The astronaut shall be firmly restrained in the support couch by a restraint harness assembly (Drawing No. 45-82702). The restraint harness shall provide satisfactory support for conditions of maximum acceleration and shall consist of two

~~CONFIDENTIAL~~

DATE 26 November 1962

ST. LOUIS, MISSOURI

PAGE

26

REVISED _____

REPORT

6603-15A

REVISED _____

~~CONFIDENTIAL~~MODEL Mercury Spacecraft

3.8.2 ASTRONAUT RESTRAINT SYSTEM - (Continued)

shoulder harness assemblies, a chest strap, a lap belt assembly, and an inverted "V" crotch strap assembly. Webbing shall be of dacron material in accordance with Specification MIL-W-25361. The shoulder harnesses shall be of the conventional type and shall be held in tension automatically by spring-loaded reels. During ascent and descent, the reels shall be locked in the fully restrained position to prevent astronaut movement out of the support couch. When unlocked for the normal restrained position, the reels shall provide a light restraining force to aid positioning and to provide the astronaut with proprioceptive cues during weightless flight. Reel locks shall be disengaged by actuation of a control lever located to the upper left of the seat assembly. The lap belt shall be of conventional type with a center coupling. Eyelets on the shoulder harness straps and inverted "V" crotch strap shall engage the lap belt coupling so that disconnecting the lap belt coupling will release lap belt, shoulder harness, and crotch straps. The lap belt shall have quick release fittings on each end for ease of installation in the spacecraft. Knee and upper leg restraint shall be effected by means of a manually-retractable restraint assembly. This assembly shall consist of two fittings, pivotally-attached to either side of the support couch, joined by a cross-brace which extends transversely behind and beneath the astronaut's knees. The assembly shall be locked in the extended (functional) position by a spring-loaded over-center strut mechanism which may be folded as the restraint assembly is moved to the stowed position. The restraint installation shall incorporate provisions for positive latching in the stowed position. Fiberglas cups shall be provided for heel and toe restraint.

3.8.3 ASTRONAUT APPAREL - The pressure suit, helmet, and parachute harness worn by the astronaut shall be furnished by NASA. The pressure suit shall be a Goodrich-Mercury type and shall include mechanical and electrical connections to mate with spacecraft fittings and terminals for biomedical measurements, oxygen breathing and face piece seal lines and communications. Provisions shall be made for urine collection within the pressure suit.

3.8.4 FOOD AND WATER - The astronaut's food shall be NASA-furnished and packaged, and contained in the special equipment container (see Paragraph 3.8.5.1). The primary water supply shall be contained in two 3-pound capacity bladders installed in a single pressure-tight partitioned enclosure mounted on the spacecraft structure above and to the right of the astronaut. Positive expulsion is insured by a hand-squeezed rubber bulb which pressurizes the space between the enclosure and bladders, collapsing the bladders and expelling the water through a retracting drinking tube which is stowable during periods of nonuse. Water from these bladders shall be available from prelaunch to the time of astronaut egress, at which time the secondary water supply contained in the survival kit may be used. A 2500-cc NASA-furnished water bladder shall be installed in the survival kit (see Paragraph 3.17.4). The water contained in this bladder shall be

~~CONFIDENTIAL~~

DATE 26 November 1962**MCDONNELL**

ST. LOUIS, MISSOURI

PAGE 27

REVISED _____

REPORT 6603-15A

REVISED _____

~~CONFIDENTIAL~~MODEL Mercury Spacecraft

3.8.4 FOOD AND WATER - (Continued)

available to the astronaut for use during the mission and after egress through a retracting drinking tube which shall be stowed in a pocket along the upper edge of the survival kit. The survival kit shall also contain a desalting kit for water supply after a water landing (see Paragraph 3.17.4). Contents of the environmental control system coolant and condensate tanks may be used as a water supply after landing by severing the closed end of a tube attached to either tank.

3.8.5 MISCELLANEOUS EQUIPMENT - Miscellaneous equipment shall be provided for the comfort, safety, and convenience of the astronaut. Provisions shall be incorporated for stowage and/or retention of this equipment within a specified area such that vibrations encountered during the mission do not result in displacement and/or detachment of equipment.

3.8.5.1 SPECIAL EQUIPMENT CONTAINER - Mounting provisions shall be incorporated for a special equipment container for stowage of the astronaut's food supply, knife, optical instruments, and other tools and/or equipment necessary in performing assigned mission tasks. Final determination of container configuration and contents shall be accomplished at the launch site.

3.8.5.2 WINDOW POLE AND FLASHLIGHT INSTALLATION - A window pole and flashlight installation (Drawing No. 45-81098) shall be mounted on the spacecraft inner structure forward and to the left of the astronaut. The window pole and flashlight shall be retained in a bracket assembly by spring-clip detents. Retracting cord assemblies shall prevent the window pole and flashlight from floating while in a weightless condition. The flashlight shall be furnished by NASA (see Appendix I-A). The window pole assembly shall be designed for the astronaut's use in actuating the window filter latches, extended view mirror, guarded push buttons, or any other function he may deem necessary or convenient.

3.8.6 NOISE AND VIBRATION - The anticipated noise level which shall reach the astronaut is estimated to be below 135 decibels during maximum "g" conditions. Noise levels shall be attenuated by the cabin insulation and by the astronaut's apparel. The noise attenuation provided shall be great enough to permit two-way communication by proper selection of microphones and earphones. Vibrations imposed shall be lessened by absorption within the support couch structure.

3.8.7 AEROMEDICAL SENSING EQUIPMENT - Aeromedical sensing equipment shall be as specified in the following paragraphs. Instrumentation shall be as specified in Paragraph 3.8.9 and as depicted in Figure 8a, Page 82.

~~CONFIDENTIAL~~

MCDONNELL

DATE 26 November 1962

ST. LOUIS, MISSOURI

PAGE 28

REVISED _____

REPORT 6603-15A

REVISED _____

~~CONFIDENTIAL~~

MODEL Mercury Spacecraft

3.8.7.1 ELECTROCARDIOGRAM - Indications of EKG shall be provided by four normal leads which shall provide two outputs for transmission by the telemetry system. One output shall be derived from a left side and a right side lead; and the other output from an upper chest and a lower chest lead.

3.8.7.2 RESPIRATION SENSING SYSTEM - An impedance pneumograph type respiration sensing system shall be provided for monitoring the astronaut's respiration rate. The varying impedance across the chest cavity during respiration cycles shall modulate a 50-kc voltage existing between a left side lead and a right side lead. The modulated signal is amplified and rectified, and the resulting D.C. signal is applied to the 1.3 kc VCO.

3.8.7.3 BODY TEMPERATURE - A rectal temperature pickup shall be provided for recording the astronaut's body temperature.

3.8.7.4 BLOOD PRESSURE MEASURING SYSTEM - A semiautomatic blood pressure measuring system (Drawing No. 45-88727) shall be incorporated. This system shall be capable of measuring the astronaut's blood pressure and converting this pressure measurement into an electrical signal. The system shall be actuated manually by the astronaut by a blood pressure START push button located on the lower left-hand console. When the START button is pushed, an initiating voltage shall be applied to the system for five seconds. During this time, the occluding cuff shall be pressurized and the pulse sensing system shall be energized. After five seconds, the initiating signal shall be removed, allowing the cuff pressurization to bleed off at a predetermined rate. The pulse sensing system shall remain energized for approximately 110 seconds. Immediately upon de-energization of the pulse sensing system, the BPMS shall be ready for a manual actuate signal to repeat the cycle. The system may be interrupted at any time by astronaut actuation of a STOP push button adjacent to the START push button. Upon deactivation of the system in this manner, all BPMS operations shall immediately cease, and the system shall be ready for a manual actuate signal to repeat the cycle.

3.8.8 CONSOLES AND CONTROLS

3.8.8.1 CONSOLES

3.8.8.1.1 RIGHT-HAND CONSOLE - The right-hand console (Drawing No. 45-81002) shall contain controls for cabin temperature, suit temperature and oxygen supply. These controls shall be accessible to the astronaut while in the fully pressurized condition. The right-hand console shall be finished in light blue spacecraft coating XA-266, compatible with the life support color code as applied to the main instrument panel.

~~CONFIDENTIAL~~

DATE 26 November 1962

ST. LOUIS, MISSOURI

PAGE 29

REVISED _____

REPORT 6603-15A

REVISED _____

CONFIDENTIALMODEL Mercury Spacecraft

3.8.8.1.2 LEFT-HAND CONSOLE - The left-hand console (Drawing No. 45-81110) shall consist of two panels; the inner panel adjoining the instrument panel which shall contain the ABORT light, LAUNCH CONTROL switch, RETRO ROCKET ARM switch, and sequence system with manual override controls (see Paragraph 3.8.9.4); and, the outer panel which shall contain the SQUIB ARM switch, AUTO RETRO JETTISON ARM switch, RECOVERY ARM switch, RESERVE FUEL PRESS switches, fuel controls, RETRO DELAY switch, cabin pressurization controls, RESCUE switch, BLOOD PRESS switches, RCS CON fuel interconnect switch, and CABIN LIGHTS switch. The left-hand console inner panel shall be finished in light brown spacecraft coating XA-263, and the outer panel shall be finished in dark brown spacecraft coating XA-264, except for the pressurization controls area which shall be finished in light brown XA-263. The DECOMP handle shall be finished in red spacecraft coating XA-214 and the REPRESS handle shall be finished in white spacecraft coating XA-213.

3.8.8.2 CONTROLS - In addition to the console controls specified in the preceding paragraphs, the astronaut shall be provided with an abort handle to his left and with a manual control system hand controller to his right.

3.8.8.2.1 HAND CONTROLLER - The manual system hand controller (Drawing No. 45-61010) shall provide the astronaut a means of manually controlling the spacecraft attitude in three axes. The hand controller shall be operable by the astronaut while in the restrained condition through wrist articulation and palm pivot motion only, but shall be structurally designed for full astronaut effort. The hand controller shall be stick-type control providing a firm hand-hold for the astronaut. Latching of the hand controller shall be provided by a ground safety pin which shall be removed prior to launch. The hand controller shall be mass balanced such that accelerations up to 3 "g" which are perpendicular to the spacecraft axis of symmetry do not effect control system movement. The manual control system hand controller shall be designed to minimize longitudinal acceleration control forces, and shall be spring-loaded to provide a feel system. By switching the ASCS MODE SELECT switch (P-19 on the Functional Profile, Figure 6, Page 66) to the FLY-BY-WIRE position, the astronaut may selectively energize the solenoid valves of the automatic reaction control subsystem through limit switches actuated by the hand controller. This shall provide the "fly-by-wire" mode through utilization of automatic control system fuel while bypassing the system's inherent electronics (see Paragraph 3.10.1.1). Controller motions of approximately 25 percent and 75 percent of full travel shall activate the low and high thrust reaction control solenoid valves, respectively, dependent on the position of the FEW THRUST SELECTOR switch on the main instrument panel. With this switch in LOW & HIGH position, both thrust levels are actuated; with the switch in LOW ONLY position, the high thrust solenoids are locked out until retrograde rocket firing. The hand controller shall be connected to the modulated manual control throttle

CONFIDENTIAL

3.8.8.2.1 HAND CONTROLLER - (Continued)

valves in the reaction control system by conventional linkage which shall be covered with fabric boots to provide protection from fouling by floating debris. A "mechanical fuse" type linkage shall be incorporated in one bellcrank in each axis (pitch, roll, and yaw) to prevent loss of "fly-by-wire" control mode in that axis due to an inoperative throttle valve. This linkage shall consist of a two-piece, pivoted bellcrank, retained in its rigid configuration by an aluminum pin, which may be sheared by the astronaut if necessary by applying additional force to the hand controller.

Total nominal travel of the hand controller shall be ± 13 degrees from neutral in roll and pitch axes and ± 10 degrees in the yaw axis. Actuation in an up and down direction, about a pivot at the wrist, shall provide an upward and downward movement about the spacecraft pitch axis. Rotary displacement in a clockwise or counterclockwise direction, in a transverse plane with respect to the pivot point below the astronaut's wrist, shall provide a similar movement about the spacecraft roll axis. Actuation of the stick grip by palm pivot motion in a right or left direction shall provide a similar movement about the yaw axis (see Figure 4, Page 44).

3.8.8.2.2 ABORT HANDLE - The abort handle (Drawing No. 45-61002) shall provide the astronaut with a means of manually initiating the escape sequence. The abort handle shall be located on the astronaut's left and shall be operable by the astronaut while in the restrained condition. The handle shall be a stick type, flanged at the upper extremity to prevent the astronaut's hand from inadvertently slipping off. A recessed unlock button, which must be depressed to release the handle for actuation, shall be located on the top. A microphone button, accessible for thumb operation, shall be provided on the upper end of the handle adjacent to the handle release button. The handle, when rotated twenty-seven degrees in a counterclockwise direction about its pivot point, shall initiate the escape sequence.

3.8.9 INSTRUMENTATION AND DISPLAYS - A main instrument panel assembly (Drawing No. 45-81100) shall be provided for astronaut indication of emergency, environment, vehicle and operational measurements, and shall be supported by spacecraft structure. All instruments shall have white indices on black background. The instrument panel shall be coded to indicate specific functional areas by color. These shall be as follows:

DATE 26 November 1962
REVISED _____
REVISED _____

MCDONNELL

ST. LOUIS, MISSOURI

PAGE 31
REPORT 6603-15A
MODEL Mercury Spacecraft

3.8.9 INSTRUMENTATION AND DISPLAYS - (Continued)

<u>FUNCTION</u>	<u>SPACECRAFT COATING</u>
Life Support	Light Blue XA-266
Electrical	Light Green XA-267
Radio	Dark Green XA-269
Warning	Medium Green XA-268
Flight	Light Grey XA-265
Altitude and Descent	Tan XA-262
Fuel Indication	Dark Brown XA-264

Basic instrumentation, depicting transmitting and/or recording methods for obtaining measurements defined below, shall be illustrated in Figure 8a, Page 82. Instrumentation specified below shall be provided by the contractor, except for cosmic ray recorders which shall be furnished by NASA.

<u>a. Aeromedical</u>	<u>Astronaut's Indication</u>	<u>Recording Method (See Figure 8)</u>
Electrocardiogram	-	x
Blood Pressure	-	x
Respiratory Rate	-	x
Body Temperature	-	x
Astronaut Motion and Appearance	-	x
Voice	-	x
<u>b. Spacecraft Environment</u>		
Primary and Secondary O ₂ Quantity (Pressure)	x	x
Cabin O ₂ Partial Pressure	x	x
Cabin Pressure	x	x

CONFIDENTIAL

DATE 26 November 1962

REVISED _____

REVISED _____

PAGE 32REPORT 6603-15AMODEL Mercury Spacecraft~~CONFIDENTIAL~~

3.8.9

INSTRUMENTATION AND DISPLAYS - (Continued)

<u>Spacecraft Environment</u>	<u>Astronaut's Indication</u>	<u>Recording Method (See Figure 8)</u>
Cabin Air Temperature	x	x
Suit CO ₂ Partial Pressure	x	x
Suit Pressure	x	x
Suit Inlet Air Temperature	x	x
c. <u>Vehicle Measurements</u>		
Longitudinal Acceleration (See Paragraph 3.8.9.3)	x	x
Time Reference (See Paragraph 3.8.9.1)	x	x
Static Pressure (Altitude)	x	x
Structural Temperatures	-	x
Equipment Temperatures	x	x
Astronaut Control Motions (Pitch, Roll and Yaw)	-	x
ASCS Amplifier-Calibrator Outputs (Pitch, Roll and Yaw)	-	x
Attitude and Angular Rate (See Paragraph 3.8.9.2)	x	x
Rate of Descent	x	-
Umbilical Door Position	x	-
Retro-Rocket Firing (See Paragraph 3.11.3)	x	x

~~CONFIDENTIAL~~

DATE 26 November 1962**MCDONNELL**

ST. LOUIS, MISSOURI

PAGE 33

REVISED _____

REPORT 6603-15A

REVISED _____

CONFIDENTIALMODEL Mercury Spacecraft

3.8.9

INSTRUMENTATION AND DISPLAYS - (Continued)

<u>d. Operational Measurements</u>	<u>Astronaut's Indication</u>	<u>Recording Method (See Figure 8)</u>
A.C. Voltage	x	x
D.C. Voltage	x	x
D.C. Current	x	x
Sequence of Events and System Malfunction (See Paragraph 3.8.9.4)	x	x
Fuel Quantity	x	x
Fuel Pressure	x	-
Pilot Abort	x	x
Horizon Scanner Operation	-	x
Low Thruster Firing	-	x
Instrumentation Calibration Signal	-	x
Command Receiver Signal Strength	-	x
Command Receiver All-Channel	-	x
Salient Mission Events	x	x
<u>e. Scientific Observations</u>		
Cosmic Radiation	-	x
<u>f. Warnings</u>		
CO ₂ Pressure	x	-
O ₂ Emergency	x	x
O ₂ Quantity	x	-

CONFIDENTIAL

DATE 26 November 1962**MCDONNELL**

ST. LOUIS, MISSOURI

PAGE 34

REVISED _____

REPORT 6603-15A

REVISED _____

CONFIDENTIALMODEL Mercury Spacecraft

3.8.9

INSTRUMENTATION AND DISPLAYS - (Continued)

<u>Warnings</u>	<u>Astronaut's Indication</u>	<u>Recording Method (See Figure 8)</u>
Excess H ₂ O	x	-
Standby AC-Auto	x	-
Fuel Quantity	x	-
Retro Warning	x	-
Retro Reset	x	-
Out of Orbit Mode	x	-

3.8.9.1

SATELLITE CLOCK - A satellite clock (Drawing No. 45-81710) shall be provided. This clock, a spring-driven chronometer, shall indicate time of day, elapsed time from launch, retrograde initiation time, and time remaining until retrograde initiation. A "time zero" reference shall be established in the clock at liftoff. The retrograde timing mechanism shall provide a firing signal for retrograde initiation. Signals of elapsed time from "time zero" and retrograde time shall be transmitted to telemetry as indicated in Figure 8a, Page 82. The retrograde set device, which may be reset manually or by ground signals, shall provide ground-monitored automatic retrograde firing. A "time-to-go" light shall be lighted yellow for a period of 5 minutes prior to retrograde initiation.

3.8.9.2

ANGULAR RATE AND ATTITUDE INDICATOR - A combined angular rate and attitude indicating system (Drawing No. 45-81721) shall be provided. The astronaut's display shall indicate pitch, roll and yaw angles and angular rates within limitations imposed by system input sources. Pitch angles shall be indicated in the range of -130 degrees to +190 degrees. Yaw angles shall be indicated in the range of -70 degrees to +250 degrees. Roll angles shall be indicated in the range of -85 degrees to +85 degrees. The pitch needles shall be color coded pink, the yaw needles shall be color coded yellow, and the roll needles shall be color coded flat white. Colors shall be in accordance with FED-STD-595. The attitude portion of the indicator shall be driven by signals obtained from the automatic stabilization and control system (see Paragraph 3.10.1). Pitch and yaw rate transducers shall have a full scale output of +6 degrees per second. Roll rate transducers shall have a nominal full scale output of +6 degrees per second, switchable to +15 degrees per second by an external switch. The orbit and retrograde index point on the indicator shall be aligned with the zero pitch rate at 34 degrees (heat shield up) on the pitch indicator dial. The indicator shall provide the astronaut with necessary indications so that he may damp out dynamic oscillations in event of malfunction of the automatic stabilization and control system.

MCDONNELLDATE 26 November 1962

ST. LOUIS, MISSOURI

PAGE 35

REVISED _____

REPORT 6603-15A

REVISED _____

MODEL Mercury Spacecraft~~CONFIDENTIAL~~

3.8.9.3 ACCELERATION INDICATION - An accelerometer (Drawing No. 45-81702) shall be provided for the longitudinal axis only. The accelerometer shall be a modification of the Specification MIL-A-25719 type and shall include positive and negative "g" memory pointers.

3.8.9.4 SEQUENCE SYSTEM AND OVERRIDE CONTROLS - The sequence system shall consist of engraved nameplates and telelight sequence lights with adjacent manually operated override controls. This system shall indicate functional sequence of events by illumination of a green light for normal sequential operation or, after a time delay, by a red light indicating a malfunction and need for subsequent override action. After corrective action has been taken, the telelight shall illuminate green as in normal sequential operation. In order of chronology, the following shall appear on the left-hand console:

NOMENCLATURE	CONTROL TYPE	SWITCH NO.	PRESENTATION
Launch Control	Toggle Switch	P-1	Engraved Nameplate
Jett Tower	Pull Ring	P-3	Telelight
Sep Capsule	Pull Ring	P-4	Telelight
Retro Seq	Push Button (with Plastic Cover)	P-6	Telelight
Retro Att	Toggle Switch	P-8	Telelight
Fire Retro	Push Button (with Plastic Cover)	P-7	Telelight
Jett Retro	Push Button (with Plastic Cover)	P-10	Telelight
.05g	Push Button (with Plastic Cover)	P-11	Telelight
Drogue	Push Button (with Plastic Cover)	P-12	Engraved Nameplate
Snorkel	Pull Ring	--	Engraved Nameplate
Main	Pull Ring	P-13	Telelight
Reserve	Pull Ring	P-14	Engraved Nameplate

~~CONFIDENTIAL~~

DATE 26 November 1962

ST. LOUIS, MISSOURI

PAGE 36

REVISED _____

REPORT 6603-15A

REVISED _____

CONFIDENTIAL

MODEL Mercury Spacecraft

3.8.9.4 SEQUENCE SYSTEM AND OVERRIDE CONTROLS - (Continued)

NOMENCLATURE	CONTROL TYPE	SWITCH NO.	PRESENTATION
Landing Bag	Toggle Switch (with Switch Guard)	P-25	Telelight
Rescue	Toggle Switch (with Switch Guard)	P-15	Telelight

Switch numbers represent manual override controls and correspond to those indicated in the Functional Profile, Figure 6, Page 66.

The pull ring override controls on the left-hand console shall provide override functions by dual independent electrical systems, pyrotechnic initiators, or manually-operated linkage. The guarded push button controls shall provide override control by a dual electrical system for each function designated. The guarded toggle switches shall function in a left-right direction and their nomenclature shall be as follows (in order of sequence and left-right readings):

LAUNCH CONTROL	READY - OFF
RETRO ATT	AUTO - BYPASS
LANDING BAG	AUTO - OFF-MAN
RESCUE	AUTO - MAN

The telelight assemblies (Drawing No. 45-79720) shall be rectangular in shape and shall consist of red and green light assemblies, nomenclature caps and retention clips. Legends shall be direct reading, engraved in black on frosted glass plate nomenclature caps and shall be legible when the lights are de-energized. Colors shall be in accordance with FED-STD-3. Brightness of the lights shall be as required by MIL-STD-411 for 24-volt application.

The engraved nameplates shall be fabricated of aluminum material and shall simulate the telelight assemblies in form and size. Nomenclature on the nameplates shall be white on a black background.

3.8.9.4.1 WARNING LIGHTS - Warning lights shall be provided on a warning light panel, located on the right-hand side of the main instrument panel, except for the ABORT light which shall be located on the left-hand console above the sequence lights. The ABORT light shall be a round presentation, 1.5 inches in diameter, and shall indicate red when energized by abort command circuitry. The legend on the ABORT light shall appear dull white on a dark background when the light is de-energized. Warning telelight assemblies shall be rectangular in shape and shall consist of two amber light assemblies, nomenclature caps, and retention clips. The following warning lights (with respective indications) shall appear:

CONFIDENTIAL

DATE 26 November 1962**MCDONNELL**

ST. LOUIS, MISSOURI

PAGE 37

REVISED _____

REPORT 6603-15A

REVISED _____

~~CONFIDENTIAL~~MODEL Mercury Spacecraft3.8.9.4.1 WARNING LIGHTS - (Continued)CO₂ PRESS (Suit CO₂ Content Above 8 mm Hg.)

OUT OF ORB MODE (High Thruster Firing)

O₂ EMERGENCY (Emergency Oxygen Rate Valve Open)O₂ QUAN (Depletion of Secondary O₂ to 6500 psig)EXCESS H₂O (Low Heat-Exchanger Exhaust Temperature)

STANDBY AC AUTO (Standby Inverter in Operation)

FUEL QUANTITY (Depletion of Automatic Fuel to 10 Pounds or
Manual Fuel to 15 Pounds)

RETRO WARN (30 Seconds to Retrograde Firing)

RETRO RESET (Satellite Clock Reset From Command Receiver/
Decoder)

As a warning light circuit becomes energized, a tone generator is initiated resulting in a steady tone audible to the astronaut through his headset. The steady tone shall remain audible until the astronaut takes action to move the corresponding toggle switch in an inboard direction to the OFF position. The switches normally shall be set in the TONE position in order to permit the tone generator to be automatically audible. After a tone has been discontinued, the astronaut shall be required to place the switch in the TONE position for reset in event another warning occurs in that particular circuit.

3.8.9.5 INDICATOR LIGHTS - Indicator lights shall be incorporated on the main instrument panel and left-hand console to apprise the astronaut that specific sequential functions have occurred or that intermittently-operated equipment is energized. Indications shall be provided for tape recorder operation and water separator piston travel (on main instrument panel), umbilical door closure and retrograde rocket firing (on left-hand console). The RECORDING light shall be identical (except for color) to the telelight assemblies described in Paragraph 3.8.9.4.1 and shall be illuminated green during periods of tape recorder operation. The RETRO FIRED light assembly shall consist of three green lights of the same type, arranged in a linear pattern above sequence numbers which correspond to the retrograde rockets. These lights shall be energized in sequential order by retrograde rocket ignition signals. The UMBILICAL DOOR light shall be identical to the sequence telelights described in Paragraph 3.8.9.4 and

DATE 26 November 1962**MCDONNELL**

ST. LOUIS, MISSOURI

PAGE

38

REVISED

REPORT

6603-15A

REVISED

MODEL

Mercury Spacecraft

~~CONFIDENTIAL~~3.8.9.5 INDICATOR LIGHTS - (Continued)

shall be illuminated green upon closure of the umbilical door. The WATER SEPARATOR TRAVEL light display shall consist of two amber light assemblies, mounted side by side on a single panel above the legends PARTIAL and FULL. When the water separator piston is inoperative, both lights shall be de-energized. During the time the piston is between the "at rest" and "full travel" positions, the PARTIAL light shall be energized. At the time the piston reaches full travel, both lights shall be illuminated.

3.8.9.6 SWITCHES AND HANDLES - The following switches and handles with their respective positions and functions shall be located on the instrument panel, left-hand console, and right-hand console as indicated. This tabulation shall exclude sequence system override controls and warning light TONE-OFF switches as specified in Paragraphs 3.8.9.4 and 3.8.9.4.1.

Type	Positions	Function Controlled	Location
Toggle Switch*	Arm - Off	Squib	Left-Hand Console
Toggle Switch*	Arm - Off	Auto Retro Jett (P-9)	
Toggle Switch*	Auto - Man	Retro Rkt Arm	
Toggle Switch*	Auto - Man	Recovery Arm	
Toggle Switch (with Guard)	Off - On	Reserve Fuel Pressurization (Manual)	
Toggle Switch (with Guard)	Off - On	Reserve Fuel Pressurization (Automatic)	
"T" Handle**	Pull to Dump - (Push to Close)	Decompress	
"T" Handle**	Pull to Repress (Push to Reset)	Repressurize	
Ring Handle	Pull Off Push On	Fuel Interconnect	
Ring Handle	Pull Off Push On	Manual Fuel Control	
Ring Handle	Pull Off Push On	ASCS Roll Fuel	

* Channel guarded.

** These shall be positively retained in the normal position by wire retention clips.

~~CONFIDENTIAL~~

DATE 26 November 1962**MCDONNELL**

ST. LOUIS, MISSOURI

PAGE 39

REVISED _____

REPORT 6603-15A

REVISED _____

~~CONFIDENTIAL~~MODEL Mercury Spacecraft3.8.9.6 SWITCHES AND HANDLES - (Continued)

Type	Positions	Function Controlled	Location
Ring Handle	Pull Off Push On	ASCS Yaw Fuel	Left-Hand Console
Ring Handle	Pull Off Push On	ASCS Pitch Fuel	
Toggle Switch	Norm - Inst	Retro Delay (P-23)	
Toggle Switch	Both - Off - L.H. Only	Cabin Lights	
Push Button	Start	Blood Pressure	
Push Button	Stop	Blood Pressure	
Push Button (with Plastic Cover)	Press	Time Zero (P-24)	Main Instrument Panel
Toggle Switch	Standby - Off Norm	Fans AC Bus	
Toggle Switch	Emerg - Norm	Audio Bus	
Toggle Switch (with Plastic Cover)	Bypass - Norm - Pwr Off	Ammeter	
Rotary Switch	250VA - 150VA Stby - ASCS - Fans	AC Voltmeter Selection	
Toggle Switch	No. 2 - Norm - No. 1	Suit Fan	
Toggle Switch	Off - Norm	Cabin Fan	
Toggle Switch	On - Off	Standby Battery	
Toggle Switch	Standby - Norm	Isolated Battery	

~~CONFIDENTIAL~~

MCDONNELLDATE 26 November 1962

ST. LOUIS, MISSOURI

PAGE 40

REVISED _____

REPORT 6603-15A

REVISED _____

~~CONFIDENTIAL~~MODEL Mercury Spacecraft

3.8.9.6

SWITCHES AND HANDLES - (Continued)

Type	Positions	Function Controlled	Location
Toggle Switch	Standby - Off - Norm	ASCS AC Bus	Main Instrument Panel
Toggle Switch	Select - Norm	ASCS Mode Select	
Toggle Switch	Fly-By-Wire - Aux. Damp	ASCS Mode Select	
Toggle Switch	Low & High - Low Only	Fly-By-Wire Thruster Select	
Toggle Switch	Off - On	Pitch Torquing	
Toggle Switch	Gyro Cage - Free - Gyro Slave	Gyro Control	
Toggle Switch	Re-entry - Orbit	Pitch Attitude	
Toggle Switch	Grnd Comd - Off - Cont	Telemetry	
Toggle Switch	Grnd Comd - Off - Cont	C-Band Beacon	
Toggle Switch	Grnd Comd - Off - Cont	S-Band Beacon	
Toggle Switch	Cont - Off - Program	Recording	
Rotary Switch	Retro - Pitch Down - Pitch Up - Yaw-L - Yaw-R - Roll CCW - Roll CW - S-2	Temperature Monitor (Switch No. 1)	
Rotary Switch	Cabin Outlet - M-250 Invert - M-150 Invert - Stby Invert	Temperature Monitor (Switch No. 2)	
Toggle Switch	Dim - Bright	Warning Lights	

~~CONFIDENTIAL~~

MCDONNELLDATE 26 November 1962

ST. LOUIS, MISSOURI

PAGE 41

REVISED _____

REPORT 6603-15A

REVISED _____

~~CONFIDENTIAL~~MODEL Mercury Spacecraft3.8.9.6 SWITCHES AND HANDLES - (Continued)

Type	Positions	Function Controlled	Location
Toggle Switch	R/T - Norm	UHF DF (P-21)	Main Instrument Panel
Toggle Switch (with Hood Guard)	Bypass - Norm	Inlet Valve Power	
Toggle Switch*	HF - UHF - Off	Transmit	
Toggle Switch	Record - Off - Trans	Voice - Controlled Relay Power	
Rotary Switch	M - I - 1 - 2 - 3 - Sby 1 - Sby 2 - Isol	DC Voltmeter Select	
Toggle Switch	Light Test	Light Test	
Toggle Switch	Auto-Man On	Rate Indicator	
Toggle Switch	Man - Auto	Sponge Squeeze	
Knob	H - 1 thru 9 - C	Suit Temperature	Right-Hand Console
Knob	H - 1 thru 9 - C	Cabin Temperature	
Handle	Emerg - Norm	Emergency O ₂	

* Channel Guarded Switches

3.8.9.7 FUSE SWITCHES - Fuse switches shall be provided for manual reset of interrupted circuits, but actuation by the astronaut shall be based upon his knowledge of the spacecraft systems and their functions. No special visual system for indication of an interrupted circuit shall be provided. Fuse switches shall be located on the main instrument panel and on a switch panel (Drawing No. 45-81014) located to the astronaut's left, adjacent to the outer panel of the left-hand console. A solid conductor shall be installed in one position of each switch in critical circuits (indicated below by *) to prevent complete loss of any of these circuits due to a blown fuse. The tips of fuse switches containing solid conductors shall be marked with diagonal black and white stripes for rapid identification. Remaining tips shall be solid white for improved visibility.

~~CONFIDENTIAL~~

DATE 26 November 1962**MCDONNELL**

ST. LOUIS, MISSOURI

PAGE

42

REVISED _____

REPORT

6603-15A

REVISED _____

~~CONFIDENTIAL~~MODEL Mercury Spacecraft3.8.9.7 FUSE SWITCHES - (Continued)

The following fuse switches shall be located on the extreme right of the main instrument panel:

Suit Fan	Envir. Contl*
Retro Jett*	Retro Man*
Emer Cap Sep Contl*	Twr Sep Contl*

The following fuse switches shall be located on the switch panel:

Fuel Jettison	No. 1 Retro Rckt	Emer Main Deploy*
Programmer	No. 2 Retro Rckt	Reserve Deploy*
Blood Press	No. 3 Retro Rckt	Emer Reserve Deploy*
Emer Escape Rckt	Retro Seq*	Emer Land Bag
Emer Tower Sep	Emer Retro Jett	Emer Rescue Aids
Emer Tower Jett	ASCS .05G	Main Disconnect
Emer Posgrd	Emer .05G	Ant Switch
Aux BCN	Emer Drogue Deploy	Comd Rcvr A
	Emer Main Disc	

* Contains one solid conductor

3.8.10 LIGHTING - Lighting for the cabin instruments and camera shall be a dual A.C. system utilizing floodlights located in the pressurized area. The lights (Drawing No. 45-79738) shall consist of two white, six-inch fluorescent tubes, each providing 4 watts illumination. These lights shall be located to the right and left of the astronaut, one to a side. Each of these lights shall incorporate a dimmer slide to permit variation in light intensity. The slides shall conform to the curvature of the lights and shall contain tabs to permit actuation by the astronaut. The slides shall be maintained in any position by friction and shall be operable through any selected light intensity from bright to full dark. For day-to-night adaptation, each of these light assemblies shall have a red filter slide mounted in the inner track of the slide assemblies. The filter slides shall contain knobs to permit actuation by the astronaut and shall be operable either with or independent of the dimmer slides. The filter shall be positioned either in the full "on" or full "off" position and shall remain positioned by friction.

~~CONFIDENTIAL~~

CONFIDENTIAL

INSTRUMENT PANEL AND CONSOLES

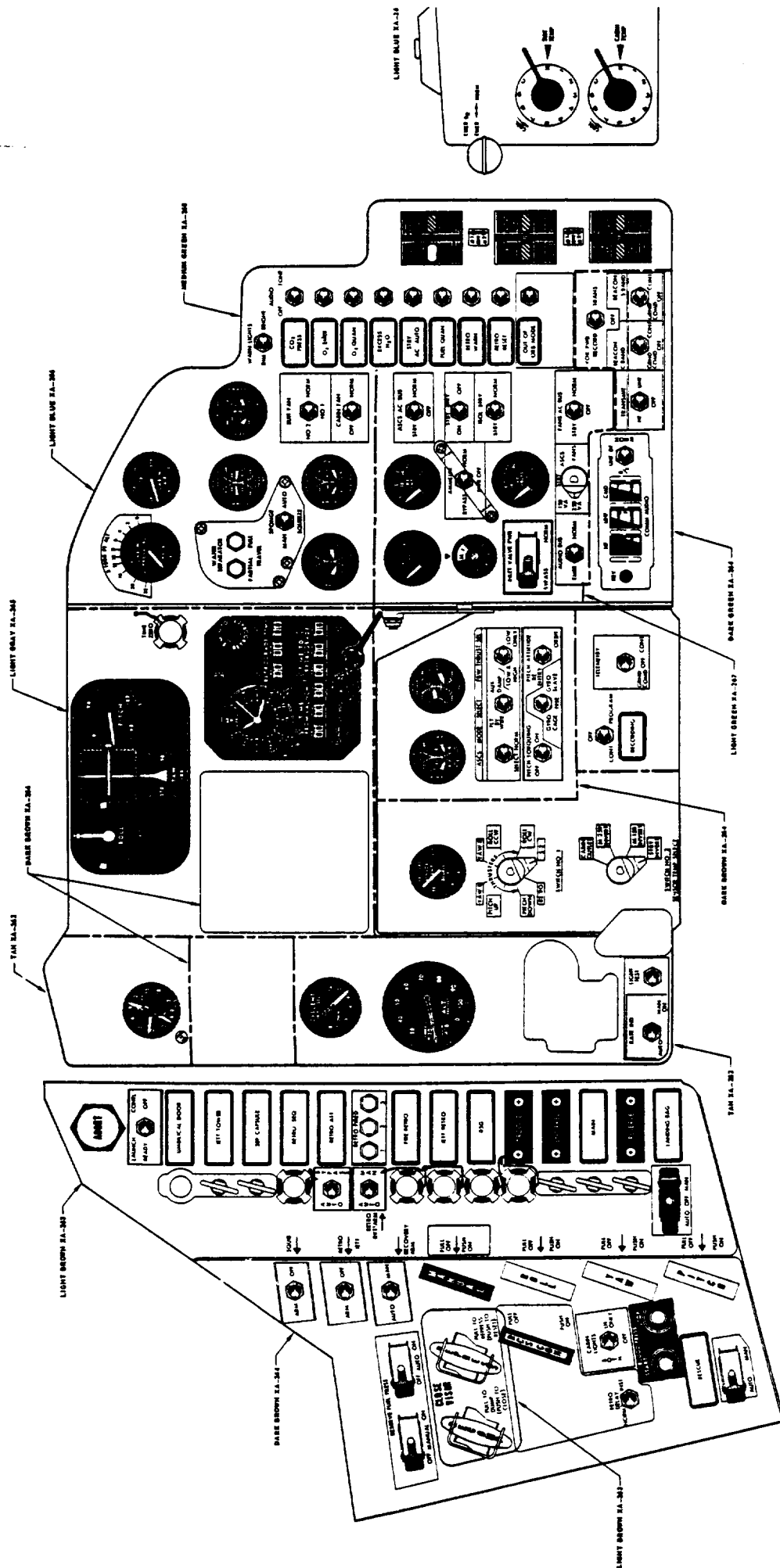


FIGURE 3

CONFIDENTIAL

DATE 26 NOVEMBER 1962
REVISED _____
REVISED _____

MCDONNELL

ST. LOUIS, MISSOURI

PAGE 44
REPORT 6603-15A
MODEL MERCURY SPACECRAFT

THREE-AXIS HAND CONTROLLER

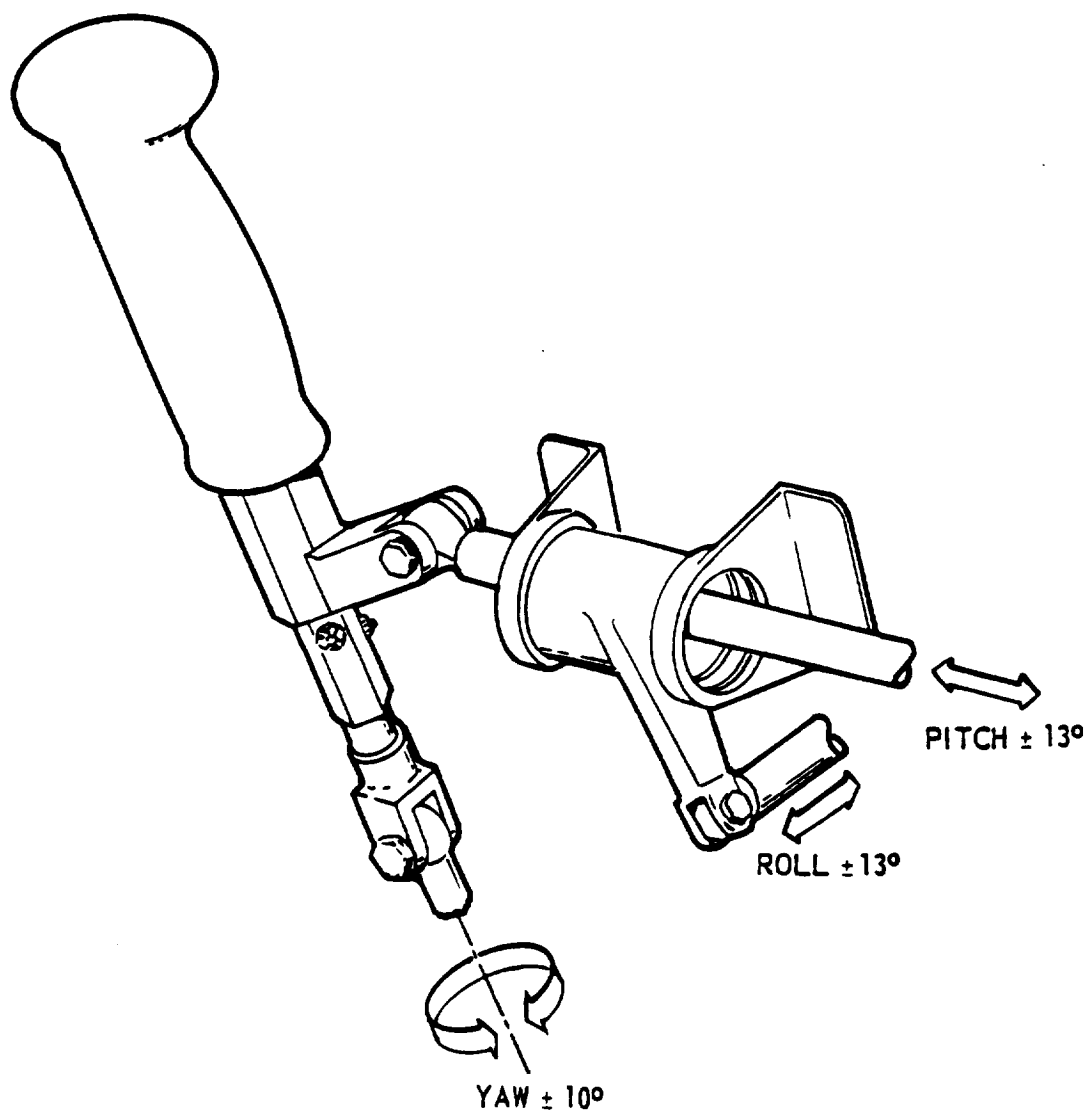


FIGURE 4

DATE 26 November 1962

MCDONNELL

ST. LOUIS, MISSOURI

PAGE 45

REVISED _____

REPORT 6603-15A

REVISED _____

CONFIDENTIAL

MODEL Mercury Spacecraft

3.9 SPACECRAFT ENVIRONMENTAL CONTROL

3.9.1 ENVIRONMENTAL CONTROL SYSTEM - Control of suit and cabin environment shall be accomplished by means of an environmental control system (Drawing No. 45-83700). The environmental control system shall provide the following:

- a. Environmental control, pressure suit (internal circuit)
- b. Environmental control, cabin and equipment
- c. Cabin pressure relief
- d. Post-landing ventilation
- e. Cooling, prelaunch

3.9.1.1 DESCRIPTION - The environmental control system shall consist of a gaseous oxygen supply that shall furnish breathing, ventilation, and pressurization gas for the pressure suit and cabin. The environmental control system shall be designed to automatically control the environmental conditions within the pressure suit and cabin during all phases of the mission as described in Paragraph 1.1.1. Separate evaporative heat exchangers shall cool the suit circuit and cabin. Oxygen flowing from the suit circuit compressor shall pass through the carbon dioxide (CO₂) and odor absorber, which shall be divided into individual sections that shall contain a supply of activated charcoal and lithium hydroxide (LiOH). The activated charcoal shall remove odor and the LiOH shall remove the CO₂ from the gas flow. Filters shall be incorporated in the absorber to filter any charcoal or LiOH dust from the gas flow. An O₂ partial pressure sensing system shall transmit a signal proportional to the amount of O₂ partial pressure in the cabin to the indicator provided on the main instrument panel. A CO₂ partial pressure sensing system shall transmit a signal proportional to the amount of CO₂ partial pressure in the suit circuit to the indicator provided on the main instrument panel.

Moisture condensed in the pressure suit heat exchanger shall be absorbed and retained in a vinyl sponge. At timed intervals, the sponge shall be automatically compressed to force the condensate from the sponge to a condensate tank for storage. The sponge may also be compressed manually by actuating a switch on the main instrument panel. The sponge shall be compressed by a piston actuated by oxygen pressure. Gas flow from the pressure suit passes through a solids trap which shall remove any foreign matter, such as food particles, hair, nasal excretion, etc., from the suit circuit gas supply. The solids trap shall incorporate a relief feature to prevent the possibility of foreign matter blocking suit circuit flow.

CONFIDENTIAL

3.9.1.1 DESCRIPTION - (Continued)

During re-entry, at approximately 17,000 feet, ambient air shall be directed into the cabin for cooling and ventilating. The equipment shall be as simple and passive in operation as practicable and shall provide the following:

- a. Metabolic oxygen, pressurization and ventilation in the pressure suit and cabin.
- b. Pressure suit ventilation for 12 hours of the post-landing phase.
- c. A selectable cabin temperature between 50°F and 80°F during orbit.
- d. Comfortable humidity-temperature level within the pressure suit during all phases of flight.
- e. Carbon dioxide, moisture, odor, and solids removal.
- f. Suit and cabin pressure regulation during all phases of flight.
- g. A decompression feature for fire extinguishing.
- h. Satisfactory operation in a weightless or high "g" environment.
- i. A secondary oxygen supply.

3.9.1.2 OPERATIONAL SEQUENCE

3.9.1.2.1 PRELAUNCH - During spacecraft prelaunch operation, the suit circuit (with facepiece closed) and cabin shall be purged with oxygen from an external low pressure source. Freon 114 refrigerant shall be introduced into the pressure suit and cabin heat exchangers from an external source through the spacecraft umbilical connection to provide cooling for the suit and cabin. Cabin and suit temperatures shall be controlled by the ground crew by regulation of the Freon 114 flow to the heat exchangers. Prior to launch, the internal oxygen supply shall be activated by a ground crewman. Breathing gas from the internal O₂ supply shall be used by the astronaut during the count-down period. The Freon 114 refrigerant line shall be disconnected at spacecraft umbilical separation. A leakage check of the hatch seal shall be made by pressurizing the cabin to 19.7 psia via an external source through the cabin pressurization fitting assembly.

DATE 26 November 1962

ST. LOUIS, MISSOURI

PAGE 47

REVISED _____

REPORT 6603-15A

REVISED _____

~~CONFIDENTIAL~~MODEL Mercury Spacecraft

3.9.1.2.2 LAUNCH - During the launch operation, the cabin pressure relief valve will prevent the cabin-to-ambient differential pressure (ΔP) from exceeding 5.5 psig and shall maintain a cabin-to-ambient differential pressure (ΔP) of approximately 5.5 psig thereafter.

3.9.1.2.3 ORBITAL - The internal cabin temperatures during the orbital phase shall be dependent on the following:

- a. Direct solar radiation absorbed at the outer surface of the vehicle.
- b. Solar radiation reflected from the earth to the vehicle.
- c. Direct radiation emitted from the earth to the vehicle.
- d. Radiation emitted from the vehicle to the earth and space.
- e. Internal heat generation from the astronaut and equipment.
- f. Mass of the structure, insulation, equipment and furnishings.

Cabin temperature shall be regulated by adjustment of the cabin temperature valve. Cabin air shall be circulated by the cabin equipment fan which shall force the cabin gas through the equipment heat exchanger and around the electronic equipment. In the event of cabin pressure decay, repressurization shall be achieved by oxygen flow through the dual cabin pressure control valve. Pressure relief shall be afforded by the cabin pressure relief and emergency decompression valve.

Oxygen shall be admitted from two primary oxygen bottles through pressure-reducing valves which shall drop the pressure from 7500 psig to 100 psig. The internal circuit pressure regulator shall supply the oxygen necessary to maintain approximately a 5 psia level during the orbital period. During ascent and descent, the suit pressure regulator shall also equalize suit internal and external pressure. A separate secondary bottle in parallel with the primary supply shall admit oxygen to the system through an oxygen pressure reducer which shall drop the pressure from 7500 psig to 80 psig. The cabin and suit circuits shall constitute redundant breathing and pressure sources, permitting the facepiece to be open or closed as desired by the astronaut.

The suit circuit compressor shall force gas through the pressure suit, solids trap, carbon dioxide and odor absorber, heat exchanger and water absorber. Pressure within the suit shall be maintained at 5 psia.

~~CONFIDENTIAL~~

DATE 26 November 1962**MCDONNELL**

ST. LOUIS, MISSOURI

PAGE

48

REVISED _____

REPORT 6603-15A

REVISED _____

~~CONFIDENTIAL~~MODEL Mercury Spacecraft3.9.1.2.3 ORBITAL - (Continued)

In the event of failure of the main suit compressor, a back-up compressor shall be actuated automatically by the compressor differential pressure sensor. Should both compressors fail, the astronaut may breathe cabin atmosphere or utilize the emergency oxygen flow rate mode (see Paragraph 3.9.1.3.c). In event of a meteoric collision causing depressurization of the cabin, the astronaut shall be able to continue by using the suit circuit for the full mission time at the normal oxygen usage rate or for one orbital cycle at the emergency flow rate of approximately 0.05 lb./min. In event of fire or buildup of toxic contaminants, the cabin may be decompressed.

3.9.1.2.4 RE-ENTRY - During re-entry, the environmental control system shall function as in the orbital sequence. Prior to re-entry initiation, cabin and cabin contents shall be cooled to as low a value as possible. Suit and cabin pressures shall remain at approximately 5 psia until an altitude of 25,000 feet is reached. At 17,000 feet, external air shall be automatically circulated through the suit circuit. In an emergency, a re-entry following a double failure of the recirculation system (with or without cabin depressurization) shall be accomplished using the emergency oxygen rate to provide breathing, ventilation, and pressurization of the suit. A reflective coating on the outer surface of the pressure suit will reduce radiant heat input.

3.9.1.2.5 POST-LANDING - Operational provisions shall be incorporated in the suit circuit for a 12-hour post-orbital period. Ambient air shall be drawn into the suit circuit through a snorkel fitting, circulated, and exhausted overboard through a snorkel outlet.

3.9.1.3 OPERATIONAL MODES - The environmental control system shall operate automatically or manually in the following modes:

- a. Cabin Mode - In this mode of operation the astronaut may have his suit faceplate open to the cabin environment. The cabin temperature shall be selected by the astronaut, by actuation of the knob located on the right-hand console (see Paragraph 3.8.9.6).
- b. Suit Mode - In this mode the astronaut will have his suit faceplate closed and the cabin atmosphere will be excluded. The CO₂ content of the suit gas supply shall be maintained below 8 mm Hg. Comfortable combinations of temperature and humidity shall be selectable. Dual compressors shall be provided in the suit circuit, and the standby compressor shall be automatically switched on if the primary compressor fails. The astronaut also shall be able to switch in the standby compressor (see Paragraph 3.8.9.6). If the suit circuit fails, the emergency mode can be used. If the cabin system is operating normally when the suit circuit fails, the astronaut may open the faceplate instead of actuating the emergency mode.

DATE 26 November 1962

ST. LOUIS, MISSOURI

PAGE

49

REVISED _____

REPORT

6603-15A

REVISED _____

MODEL

Mercury Spacecraft

3.9.1.3

OPERATIONAL MODES - (Continued)

- c. Emergency Mode - In this mode of operation an automatic and/or manual emergency oxygen rate capability shall be provided. The emergency oxygen rate may be used during loss of cabin pressurization or during failure of the closed environmental control system. This oxygen shall be available for use in the suit mode (b) described above. This system shall be used through the suit by a direct open oxygen system in which expired oxygen is discharged by being dumped into the cabin and then overboard. Provision shall be made to permit the use of remaining primary oxygen supply for this mode; however, special provision shall be made to prevent loss of oxygen to the cabin system if the cabin system fails.

3.9.1.4

ENVIRONMENTAL CONTROL SYSTEM WARNING INDICATION - Amber warning lights with accompanying audio tones shall be provided on the warning light portion of the main instrument panel (see Paragraph 3.8.9.4.1) for indication of the following:

O₂ EMERGENCYO₂ QUANEXCESS H₂OCO₂ PRESS

DATE 26 November 1962

ST. LOUIS, MISSOURI

PAGE 50

REVISED _____

REPORT 6603-15A

REVISED _____

MODEL Mercury Spacecraft**CONFIDENTIAL**

3.10 STABILIZATION AND CONTROL SUBSYSTEM - The stabilization and control subsystem shall consist of the automatic stabilization and control system, the horizon scanner system, and the reaction control system. The launch trajectory control and guidance shall be considered an integral part of the launch vehicle system and shall not be the responsibility of the spacecraft contractor.

3.10.1 AUTOMATIC STABILIZATION AND CONTROL SYSTEM - The automatic stabilization and control system (ASCS) as defined in Drawing No. 45-87700 (see Appendix I-C, Item 5) shall provide automatic stabilization and orientation of the spacecraft from time of separation from the booster-adaptor until landing parachute deployment in accordance with the various phases of the mission. The ASCS shall supply output signals for display, recording and telemetering of three-axis attitude information, a discrete signal at 0.05g longitudinal acceleration during re-entry, and attitude signal sectors for use in the spacecraft retrograde firing interlock circuit. Associated equipment consisting of the horizon scanners, reaction controls, communications system telemetry, devices for display of the spacecraft attitude, and devices for generating spacecraft signals for discrete mission events, shall be utilized by the ASCS. The expenditure of propellant shall be minimized by the design of the control system.

3.10.1.1 MODES OF OPERATION - The ASCS shall have four modes of automatic operation: damping, orientation, attitude-hold, and re-entry. The ASCS shall also contain switching to allow alternate manual fly-by-wire and auxiliary damping modes. In the fly-by-wire mode, the automatic reaction control nozzles shall be controllable by the astronaut through limit switches actuated by stick controller motion. The auxiliary damping mode shall provide rate damping only and shall disengage the automatic and fly-by-wire functions. Other switching is available for manual selection of an orbit pitch attitude of either the preset retrograde attitude of 34° or the preset post-retrograde attitude of 0° , and for orbital rate pitch precession at astronaut discretion. Other than override controls, no provisions shall be made for manual stepping of the ASCS automatic sequencing. Provisions shall be made for an audio tone and light to be activated in the event of loss of attitude-hold mode (i.e., high thrust firing command) during orbit.

3.10.1.2 SEQUENCE OF OPERATION - The following general sequence of operation compatible with spacecraft sequence shall be provided by the ASCS.

- a. Rate damping in early abort cases.
- b. Rate damping, turn-around, and spacecraft orientation to the orbit attitude of 34° (blunt end up) in later aborts or after spacecraft-adaptor separation in normal orbital missions.

3.10.1.2 SEQUENCE OF OPERATION - (Continued)

- c. Orientation during orbital flight through retrograde rocket firing as follows:
 - 1. Orientation with respect to the local earth vertical (such that the astronaut's head would be up).
 - 2. Provide required spacecraft orientation prior to retrograde rocket firing.
 - 3. Hold prescribed 34° ($+5^{\circ}$) retrograde pitch attitude during retrograde rocket firing.
- d. Switching to re-entry mode at retrograde assembly jettison providing spacecraft orientation to a prescribed re-entry pitch attitude of 0° ($+5^{\circ}$) following retrograde rocket firing.
- e. Hold 0° ($+5^{\circ}$) re-entry pitch attitude until 0.05g acceleration is sensed.
- f. Switching to rate damper mode at longitudinal acceleration (from drag buildup) of 0.05g and providing a steady roll rate of approximately 10 to 12 degrees per second thereafter until disengagement.
- g. Disengagement when landing chute deploys.

The ASCS shall include, in addition to amplifier-calibrator (computing) equipment, pitch, roll and yaw rate gyros, vertical and directional attitude gyros, and a longitudinal accelerometer. The rate gyros shall sense spacecraft rotational rates, and the longitudinal accelerometer shall sense 0.05g longitudinal acceleration initiation of the re-entry mode. The attitude gyros, with signal inputs from the horizon scanners and slaving computation performed in the amp-cal, shall sense pitch, roll and yaw attitudes for an attitude reference system. The pitch and roll outputs of the horizon scanners shall be utilized to precess the gyros such that their spin axes shall be maintained in the properly erected position relative to the moving local vertical axis. Prior to launch, both the vertical and directional gyros shall be torqued so as to erect their spin axes to any desired orientation relative to the launch trajectory. During the climb phase of the mission after tower separation, the vertical gyro spin axis shall be erected to the horizon scanners. After tower separation the vertical and directional gyros and horizon scanners shall function as shown in Figure 6, Page 66. At 0.05g, the horizon scanners shall be de-energized and the spacecraft pitch and yaw angular rates shall be maintained at a value which will impose tolerable acceleration levels on the

DATE 26 November 1962

ST. LOUIS, MISSOURI

PAGE 52

REVISED _____

REPORT 6603-15A

REVISED _____

MODEL Mercury Spacecraft~~CONFIDENTIAL~~

3.10.1.2 SEQUENCE OF OPERATION - (Continued)

astronaut and equipment. At the same time, a steady-state roll rate of approximately 10 to 12 degrees per second shall be established and maintained until disengagement of the ASCS at main landing parachute deployment.

3.10.2 HORIZON SCANNER SYSTEM - A horizon scanner system (Drawing No. 45-87702) shall be provided for sensing roll and pitch attitude reference for the ASCS. The horizon scanner system shall consist of two scanner units, one unit aligned to the spacecraft pitch axis and one unit aligned to the spacecraft roll axis. The scanner assemblies shall be mounted on the structure within the antenna assembly, and shall provide a 118-degree conical scan of the horizon through a rotating prism located ahead of the scanner lens. The prism shall rotate at a speed of approximately 30 revolutions per second. Each scanner unit shall receive A.C. power inputs through the spacecraft A.C. power system and shall supply D.C. output signals of the required polarity to provide roll and/or pitch signals up to a maximum of 35 degrees for torquing the attitude gyros in the ASCS. Yaw sensing shall be achieved through torquing of vertical and directional gyros of the ASCS by horizon scanner roll signal inputs. Pitch and roll sensing shall possess sufficient accuracy to enable the astronaut to orient the spacecraft within $\pm 5^\circ$ of the orbital attitude. The scanners shall run only when the gyro control switch on the main instrument panel is in the GYRO SLAVE position. In a normal mission the scanners shall be energized at time zero and shall function as illustrated in the Functional Profile, Figure 6 Page 66.

Individual thermostatically controlled blanket heaters (Drawing No. 45-78071) shall be provided for each horizon scanner to maintain the required scanner operating temperature. These heaters shall be energized when power is applied to the 24-volt D.C. bus and shall function continuously through antenna assembly jettison.

A protective fiberglass cover assembly (Drawing No. 45-31064) shall be provided for the roll scanner. The cover shall protect the scanner glass from blast erosion from the escape rockets, and shall be automatically ejected to permit horizon scanning at tower jettison plus four seconds (see Paragraph 3.5.6).

3.10.3 REACTION CONTROL SYSTEM - The reaction control system (Drawing No. 45-61700) (see Appendix I-C, Item 6) shall consist of an automatic control subsystem and a manual control subsystem, as depicted in Figure 5, Page 55. The reaction control system shall provide control of the spacecraft in the roll, pitch and yaw axes. This system shall be a pressure-fed, monopropellant/catalyst bed design, incorporating right angle firing exhaust nozzles which shall produce thrust through decomposition of hydrogen peroxide (H_2O_2). Minimal translation motions may result upon application of reaction control thrust.

~~CONFIDENTIAL~~

DATE 26 November 1962

ST. LOUIS, MISSOURI

PAGE

53

REVISED

REPORT

6603-15A

REVISED

MODEL Mercury Spacecraft

3.10.3.1 AUTOMATIC CONTROL SUBSYSTEM - The automatic control subsystem shall basically consist of a pressurization system, fuel distribution system, and 12 thrust chamber assemblies. Each thrust chamber assembly shall consist of a solenoid valve, heat barrier, and thrust chamber. The fuel supply shall be unstabilized H_2O_2 contained inside a flexible bladder which, in turn, shall be contained in a half-toroidal tank. This system shall function automatically in conjunction with the automatic stabilization and control system. A pressure transducer in the pressurization system shall provide a means of monitoring (by the pressure-versus-volume method) the percentage of fuel present in the bladder. Sufficient fuel and pressurization gas shall be provided to maintain damper operation until main parachute deployment, at which time the fuel shall be jettisoned.

3.10.3.2 MANUAL CONTROL SUBSYSTEM - The manual control subsystem shall consist of a pressurization system, a fuel distribution system and six thrust chamber assemblies. The yaw, pitch, and roll control each consist of a pair of thrust chamber assemblies with a single proportional control propellant valve. The pressurization portion of the manual control subsystem shall be identical to the corresponding portion of the automatic subsystem. The manual subsystem shall have a smaller capacity for fuel than the automatic subsystem. The manual subsystem shall be controlled by the astronaut by means of three-axis hand controller (see Paragraph 3.8.8.2.1), and shall be capable of overcoming the disturbance torque resulting from firing the retrograde rockets.

3.10.3.3 OPERATION - High-pressure nitrogen shall be utilized to pressurize the fuel tanks. The high-pressure (3000 psig) gas shall pass through a filter and manual shutoff valve to a pressure regulator (which shall reduce the pressure to 480 psig), through a check valve, and finally surround and compress the flexible bladder of the torus tank. The pressure shall force fuel out of the bladder through the perforated tube downstream into the lines and valves. The manual push-pull shutoff valves, which allow fuel to be available at the solenoid valves, shall provide a means of individual system isolation and shutoff. The shutoff valves shall be vented overboard through a line system (Drawing No. 45-62075) to reduce the possibility of fire due to fuel leakage. Upon receiving a 24-volt D.C. signal from the ASCS, the appropriate solenoid valve shall open. The fuel shall then pass into the corresponding thrust chamber where it shall be decomposed, providing the following thrust levels for operation with the ASCS:

- a. High thrust level of 24 pounds for pitch and yaw axes and six pounds for the roll axis.
- b. Low thrust level of one pound for all three axes.

These thrust levels shall be available in discrete, short-time periods as controlled by the ASCS.

DATE 26 November 1962

ST. LOUIS, MISSOURI

PAGE

54

REVISED _____

REPORT

6603-15A

REVISED _____

MODEL

Mercury Spacecraft

3.10.3.3 OPERATION - (Continued)

A pressure transducer in the pressurization system shall provide a means of monitoring the percentage of fuel present in the bladder. The internal transfer tube shall guarantee uninterrupted and total fuel flow. The external transfer tube shall assure that no nitrogen shall be trapped during propellant filling.

The manual control subsystem shall provide proportional control and thrust levels between four and 24 pounds for pitch and yaw axes and between one and six pounds for roll axis. These thrust outputs shall be controlled from the hand controller through direct stick control.

3.10.3.4 TANKS - The pressurant tanks for each system shall be located in the cabin and shall be of spherical fiberglass construction. These tanks shall store pressurization gas at 3000 psig. The fuel tanks shall be a half-toroidal configuration contoured to mount on the aft pressure bulkhead between the bulkhead and the heat shield. The fuel tanks shall be constructed of aluminum, insulated to provide temperature control, and incorporate a flexible plastic bladder to provide pressure for positive expulsion of the fuel. Provisions for in-flight jettisoning of fuel at main parachute deployment shall be incorporated. The manual and automatic fuel tanks shall be interconnected by a line system which permits use of fuel remaining in either tank in the system normally supplied by the other tank. A manual shutoff valve shall be incorporated in the interconnecting line for optimum utilization of available fuel at the discretion of the astronaut. Check valves shall be installed in the line to prevent fuel interflow between tanks. The interconnect system shall also provide the method by which the fuel remaining in the manual tank at main parachute deployment shall be jettisoned.

Provisions for an auxiliary fuel tank of 15 pounds capacity shall be incorporated on the spacecraft. This tank shall be of the same configuration as the automatic and manual fuel tanks except for size, and shall be in parallel with the automatic control system. Pressurization shall be provided by either the manual or automatic control system pressurant as selected by the astronaut. Pressurization shall be effected through squib valves, which shall be initiated by a switch on the left-hand console. The squib valves shall remain de-energized until retrograde to insure availability of auxiliary fuel for retrograde and re-entry stabilization.

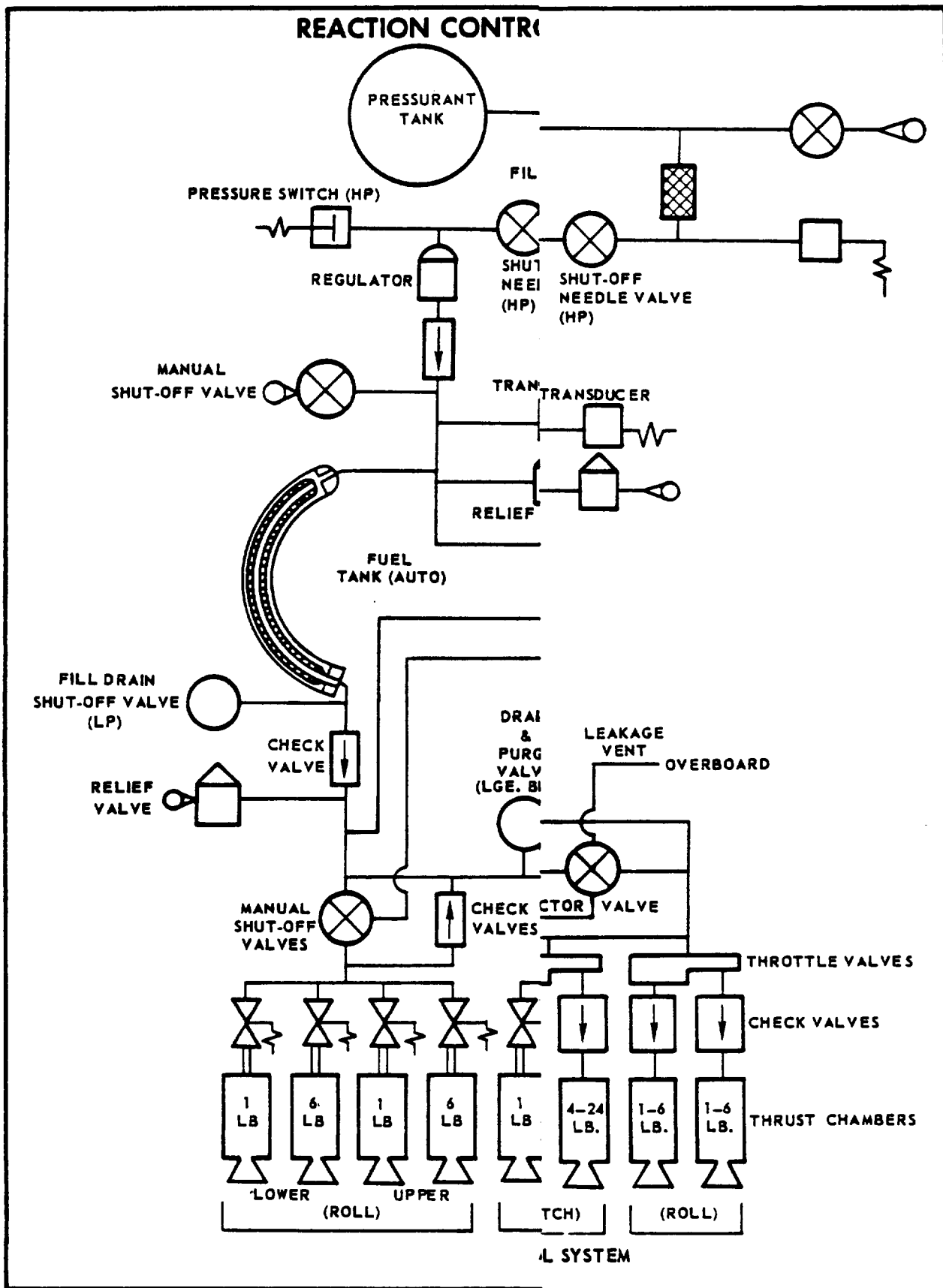
DATE 26 NOVEMBER 1962

MCDONN

ST. LOUIS, MISSO

REVISED _____

REVISED _____



DATE 26 November 1962

ST. LOUIS, MISSOURI

PAGE

56

REVISED

REPORT

6603-15A

REVISED

MODEL Mercury Spacecraft

3.11 RETROGRADE ROCKET SYSTEM

3.11.1 DESCRIPTION - The re-entry phase of the mission shall be initiated by firing a retrograde rocket system consisting of three Thiokol Model TE-316 solid propellant rockets and associated components as specified in Appendix I-C, Item 2. The target value for magnitude of the retrograde impulse shall be to provide a velocity decrement of approximately 465 feet per second for the spacecraft weight as specified in Paragraph 3.1.1.3. Each rocket shall have a vacuum impulse of approximately 12,960 pound-seconds providing an average thrust of 1070 pounds for 11.26 seconds action time under the conditions specified in Drawing No. 45-50700.

3.11.2 INSTALLATION - The retrograde rocket assembly shall be mounted on a structural frame encased within an insulated aluminum-alloy housing which shall be secured to the external surface of the heat shield by three retaining straps. The retaining straps (Drawing No. 45-72030) shall be retained at their outer ends by engagement in hook-type retention fittings (Drawing No. 45-32086). The straps, which are installed in tension, are attached to each other and to the rocket structural assembly by a centrally located explosive bolt (Drawing No. 45-72704). For spacecraft shipment, an inert bolt shall be provided, but prior to spacecraft launching an active explosive bolt shall be installed. Release of the retaining straps and retrograde rocket assembly shall be effected by separation of the explosive bolt. Removal of tension from the retaining straps shall result in their disengagement from the retention fittings. A compression spring jettison assembly (Drawing No. 45-50013) shall thrust the retrograde assembly from the spacecraft. Initiation of the ejector bolt shall be through a firing-command latching signal which shall permit retrograde rocket assembly separation after a 60-second time delay. The rockets and rocket nozzles shall be shielded by cover assemblies (Drawing No. 45-50012) for protection against meteorite penetration. These covers shall blow off as the rockets fire. The rocket assembly housing shall be finished with a paint possessing sufficient solar absorptivity characteristics to provide a relatively warm environment within the enclosure. Rocket thrust direction shall be aligned on the ground prior to launch so as to minimize eccentricity between the thrust vector and the spacecraft center of gravity.

3.11.3 IGNITION - Automatic sequencing of the retrograde operation may be initiated by a signal from any one of three sources; a signal from the satellite clock, a ground command signal via the command receiver and decoder (see Paragraph 3.14.2), or manually by astronaut override by actuation of the push button (P-6) adjacent to the RETRO SEQ. telelight. The initiating signal shall simultaneously energize a 30-second time delay relay, initiate the re-entry mode of telemetry and instrumentation, and command the ASCS to discontinue pulse-type control and assume the retrograde mode of control torque switching. ASCS electronics shall

DATE 26 November 1962

ST. LOUIS, MISSOURI

PAGE 57

REVISED _____

REPORT 6603-15A

REVISED _____

MODEL Mercury Spacecraft

3.11.3 IGNITION - (Continued)

sense an attitude within "permission" bounds of ± 30 degrees yaw, ± 30 degrees roll, and ± 12.5 degrees pitch, and energize the retrograde interlock relay in the ASCS calibrator. Closure of this relay shall energize "attitude permission" relays which shall, upon runout of the 30-second time delay relay, complete the circuit and initiate a master signal to the retrograde rocket firing circuits to sequentially fire the rockets at 5-second intervals. The individual retrograde firing signals shall initiate telemetry and on-board recording of each retrograde rocket firing. The #2 rocket firing signal shall also be applied to a retrograde timing device (Drawing No. 45-88119) which shall transmit a signal to the ground via telemetry for indication of time since retrograde rocket firing. At the same time as the master retrograde firing signal is initiated, the ASCS "attitude permission" switch shall energize a 23-second time delay relay which shall apply a "retrograde fire" signal to the ASCS for 23 seconds. Jettison of the retrograde assembly shall be as described in Paragraph 3.11.2.

3.11.4 POSIGRADE ROCKET SYSTEM - Separation of the spacecraft from the adapter-booster vehicle shall be aided by firing a posigrade rocket system (Drawing No. 45-50001) consisting of three Atlantic Research Corporation solid-propellant rockets as specified in Appendix I-C. These rockets shall have a vacuum impulse of 462 pound-seconds each, providing an average thrust of 420 pounds each for an action time of 1.01 seconds, under the conditions specified in Drawing No. 45-50701. Firing the posigrade rockets shall produce a maximum separation velocity of 28 feet per second. The posigrade rockets shall be symmetrically mounted in the retrograde rocket assembly housing between the retrograde rockets. Posigrade rocket system initiation shall be accomplished automatically through a separation signal from the spacecraft-adapter ring separation sensor after firing of the spacecraft-adapter clamp ring explosive bolts.

DATE 26 November 1962

ST. LOUIS, MISSOURI

PAGE

58

REVISED _____

REPORT 6603-15A

REVISED _____

MODEL Mercury Spacecraft

3.12 ESCAPE SYSTEM - An active escape system shall be provided as an integral part of the spacecraft. The escape system shall provide positive spacecraft-sustainer separation characteristics and adequate launch aerodynamic heating protection for the spacecraft afterbody. This system shall be capable of functioning during various periods up to tower separation should it become necessary to abort a mission and escape from the vicinity of the Atlas booster system. Escape sequence prior to and after release of the active escape system for either a normal or aborted mission shall be as specified in Paragraph 3.12.5.

3.12.1 DESCRIPTION - The escape system shall include a pylon framework assembly (Drawing No. 45-31001) which shall support an escape rocket installation (Drawing No. 45-51001). The escape rocket installation shall consist of a structural assembly, an escape rocket, a pylon jettison rocket, an aerodynamic spike, and a ballast assembly (Drawing Nos. 45-51002, 45-51700, 45-51701, 45-51017, and 45-51010, respectively). The pylon assembly shall be a tower structure consisting of three longitudinal members of tubular steel construction, diagonally braced, and shall incorporate an antenna cover assembly for shielding the antenna assembly (see Paragraph 3.5.7). The pylon shall be attached to the spacecraft cylindrical recovery compartment by a clamp ring assembly. A 45-degree aerodynamic fairing (Drawing No. 45-72045) shall be installed on the pylon ring to facilitate greater aerodynamic stability of the spacecraft up to tower separation. The clamp ring assembly (Drawing No. 45-72040) shall consist of three segmented sections joined by explosive bolts (Drawing No. 45-72702). Two of the explosive bolts shall be initiated electrically from either end by a dual electrical system. The third bolt shall be initiated electrically at one end and by a gas-generator source at the other end through a percussion system. Initiation of the clamp ring separation explosive bolts shall be as described in Paragraph 3.12.5.

3.12.2 ESCAPE ROCKET - The escape rocket (Drawing No. 45-51700) shall be supported by the pylon structure. The aerodynamic spike and ballast assembly shall be secured to the escape rocket structural assembly. The escape rocket shall consist of an electrically-actuated igniter and a solid-propellant rocket motor with three nozzles canted 19 degrees from the longitudinal axis of the rocket case. The nominal action time for the escape rocket shall be 0.78 seconds with an average resultant thrust of 52,000 pounds at its centerline. Nominal total impulse rating of this rocket shall be 56,500 pound-seconds, under conditions specified in Drawing No. 45-51700.

3.12.3 PYLON JETTISON ROCKET - The pylon jettison rocket (Drawing No. 45-51701) shall be supported by the escape rocket structural assembly. This rocket shall be mounted on the escape rocket longitudinal axis among the canted nozzles. The pylon jettison rocket shall consist of an electrically actuated igniter and a solid-propellant rocket

DATE 26 November 1962

MCDONNELL

ST. LOUIS, MISSOURI

PAGE 59

REVISED _____

REPORT 6603-15A

REVISED _____

MODEL Mercury Spacecraft

~~CONFIDENTIAL~~

3.12.3 PYLON JETTISON ROCKET - (Continued)

motor with three nozzles, each canted so as to prevent impingement of the jet blast on the blast shield. The nominal action time for this rocket shall be 1.17 seconds with a nominal average thrust of 600 pounds and total impulse of 945 pound-seconds, under conditions specified in Drawing No. 45-51701.

3.12.4 ESCAPE SYSTEM PERFORMANCE - The escape system, during an escape from the ground launching pad, shall propel the spacecraft to an altitude of approximately 2200 feet. Determination of the nominal escape rocket thrust eccentricity shall be the result of rational analysis which will attain a reasonable compromise between adequate spacecraft-booster separation distance and tolerable astronaut and structural lateral load factor characteristics. The analysis shall consider effects such as:

- a. Spacecraft abort conditions as a result of booster malfunction.
- b. Booster flight characteristics subsequent to spacecraft-adaptor separation.
- c. Spacecraft escape rocket thrust eccentricity tolerance.

The determination of booster flight conditions leading to the initiation of the abort maneuver and following spacecraft separation shall not be the responsibility of the spacecraft contractor.

3.12.5 ESCAPE SYSTEM SEQUENCE - Escape system sequence for normal or aborted missions shall be as specified in the following paragraphs.

3.12.5.1 NORMAL MISSION - Normal sequence for the mission defined in Paragraph 1.1.1 shall be as defined below (see the Functional Profile, Figure 6, Page 66).

- a. At booster liftoff (two inches off the pad) the following shall occur:
 1. The booster failure detection system shall be activated.
 2. A time zero reference shall be established in the satellite clock, maximum altitude sensor, and recording equipment.

~~CONFIDENTIAL~~

DATE 26 November 1962

MCDONNELL

ST. LOUIS, MISSOURI

PAGE 60

REVISED _____

REPORT 6603-15A

REVISED _____

CONFIDENTIAL

MODEL Mercury Spacecraft

3.12.5.1 NORMAL MISSION - (Continued)

b. At booster engine cutoff, the following shall occur:

1. A booster engine separation signal shall energize a 20-second time delay relay.
2. Upon runout of the 20-second time delay, this signal shall energize the tower bolts fire relays. Activation of these relays shall energize the tower ring separate interlock relay and the pylon clamp ring explosive bolts.
3. Initiation of the explosive bolts shall permit separation of the clamp ring segments.
4. Separation of the clamp ring segments shall actuate a sensor which shall transmit a firing signal through the previously energized tower ring interlock relay, firing the escape rocket. This signal shall also be transmitted to the thrust cutoff sensor 0.20g comparator through the normally-closed position of the tower separate abort interlock relay.
5. Firing of the escape rocket shall carry the tower from the path of the spacecraft and sustainer portion of the booster as they ascend in their trajectories to orbital insertion. As the tower separates from the spacecraft, the tower separation relay is de-energized, closing contacts which arm the landing sequence system and energize HF communications. In the event the escape rocket fails to fire, the signal which exists at the thrust cutoff sensor (see Item 4 above) shall energize a 1-second time delay relay when a thrust decay to 0.20g is sensed. Upon runout of this time delay, the signal shall initiate ignition of the tower jettison rocket, which then performs the function of the inoperative escape rocket.

c. At sustainer engine cutoff the following shall occur:

1. An accelerometer-type thrust cutoff sensor shall sense sustainer thrust decay to 0.20g, at which condition the thrust cutoff sensor shall transmit a firing signal to a 1-second time delay relay.

CONFIDENTIAL

3.12.5.1 NORMAL MISSION - (Continued)

2. Runout of this time delay relay shall energize the spacecraft-adapter bolts fire relays. Activation of these relays shall energize the spacecraft ring separation interlock relay and the spacecraft-adapter clamp ring explosive bolts.
3. Initiation of the explosive bolts shall permit separation of the spacecraft-adapter clamp ring segments.
- d. At spacecraft-adapter clamp ring separation, the following shall occur:
 1. The adapter ring limit switch sensor shall be actuated from the "not separated" to the "separated" position.
 2. Actuation of this sensor shall transmit a signal through the previously-energized spacecraft ring separation interlock relay and the "separated" position of the tower separation sensor relay, firing the posigrade rockets.
 3. Firing the posigrade rockets shall close the spacecraft-adapter separation limit switch sensor "separation" contacts.
 4. The spacecraft-adapter separation sensor shall arm the satellite clock, energize a 5-minute time delay relay which upon runout shall command the orbit mode of instrumentation, and transmit a signal through a tower separation sensor power and control relay which shall energize the following:
 - (a) A 5-second time delay relay and a power and control relay which shall command the damping mode of the ASCS until runout of the 5-second time delay relay, at which time the orbit orientation mode shall be commanded.
- e. At retrograde initiation, the following shall occur:
 1. The satellite clock shall command the ASCS to assume the retrograde attitude, initiate the instrumentation re-entry mode, energize a 30-second time delay relay and a bypass switch which permits astronaut override of the 30-second time delay relay.

MCDONNELL

DATE 26 November 1962

ST. LOUIS, MISSOURI

PAGE 62

REVISED _____

REPORT 6603-15A

REVISED _____

MODEL Mercury Spacecraft

3.12.5.1 NORMAL MISSION - (Continued)

2. Upon runout of the 30-second time delay relay, a signal shall be transmitted through the ASCS "attitude permission" relay (which is energized by an "attitude correct" signal from the ASCS) for firing the retrograde rockets.
3. At the same time as the retrograde firing signal is applied, a time delay relay shall be energized which shall apply a "retrograde fire" signal to the ASCS for a 23-second period. The retrograde timer is initiated after ignition of the second retrograde rocket motor. Firing and jettison of the retrograde rocket assembly shall be as specified in Paragraph 3.11.2 and 3.11.3.

f. At retrograde assembly jettison, the following shall occur:

1. The retrograde attitude mode of the ASCS shall be switched to a re-entry orientation mode for acceleration less than 0.05g. A 5-second time delay relay shall be energized, which upon runout, shall arm the ASCS accelerometer for sensing spacecraft acceleration greater than 0.05g for re-entry stabilization, until drogue chute deployment. Landing system sequence shall be as described in Paragraph 3.17.1.

3.12.5.2 ABORTED MISSION - Mission aborts may occur either prior to staging or after staging as defined in the following paragraphs. Abort indication shall be provided by a red ABORT light on the left-hand console (see Paragraph 3.8.9.4.1). Abort indication shall also be telemetered to ground stations and tape-recorded on board.

3.12.5.2.1 ABORT INITIATION - An abort shall be initiated by application of a 28-volt signal to the abort junction in the escape system electrical network. Upon receipt of a signal, the 28-volt source shall be instantly "locked in" at this junction and shall provide the necessary power source to initiate the abort sequence, consistent with the mode in which the abort maneuver is necessary. Mission aborts may be initiated under any of the following conditions:

- a. Prior to spacecraft umbilical separation, an off-the-pad abort may be initiated from the blockhouse.
- b. After spacecraft umbilical separation and prior to booster liftoff (two inches altitude), an abort can be initiated by radio command, by hardline which bypasses the booster lockout relay via the booster umbilical, or by the astronaut.

DATE 26 November 1962

MCDONNELL

ST. LOUIS, MISSOURI

PAGE 63

REVISED _____

REPORT 6603-15A

REVISED _____

CONFIDENTIAL

MODEL Mercury Spacecraft

3.12.5.2.1 ABORT INITIATION - (Continued)

- c. After booster liftoff, prior to booster umbilical separation, an abort can be initiated by radio command, by hard-line via booster umbilical, by the booster abort sensing and implementation system (ASIS), or by the astronaut.
- d. After booster umbilical separation and prior to booster and/or sustainer cutoff, an abort can be initiated by radio command, the booster abort sensing and implementation system (ASIS), or by the astronaut.
- e. After booster shutdown and tower jettison, but prior to sustainer cutoff, an abort can be initiated by radio command, the booster abort sensing and implementation system (ASIS), or by the astronaut.
- f. After sustainer cutoff, an abort may be initiated by radio command or by the astronaut.

3.12.5.3 ABORT SEQUENCE OFF-THE-PAD AND PRIOR TO TOWER SEPARATION -

Upon receipt of an abort command from sources a., b., c., or d. as outlined in Paragraph 3.12.5.2.1, the following shall occur:

- a. The spacecraft ABORT light shall be illuminated and the abort switches and time zero relays energized.
- b. A shutdown command shall be transmitted to the booster (Stage 1) and sustainer (Stage 2) engine systems.
- c. A power and control relay shall transmit a signal to the spacecraft ring separation interlock relay and to spacecraft-adaptor clamp ring explosive bolts through spacecraft-adaptor bolts fire relays. Initiation of the explosive bolts shall permit separation of the clamp ring segments. This shall be detected by the adapter ring separation sensor which shall transmit a firing signal to the escape rocket. Firing of the escape rocket shall propel the spacecraft from the path of the booster.
- d. Escape rocket firing shall be detected by the spacecraft-adaptor separation sensor relays which shall:
 - 1. Transmit an abort signal to a relay which shall initiate firing of the retrograde assembly explosive bolt for separation of the retrograde rocket assembly (see Paragraph 3.11.2). The retrograde assembly separation sensor shall energize a 5-second time delay relay which shall arm the ASCS accelerometer switch for sensing spacecraft conditions greater than 0.05g.

DATE 26 November 1962

ST. LOUIS, MISSOURI

PAGE 64

REVISED _____

REPORT 6603-15A

REVISED _____

~~CONFIDENTIAL~~

MODEL Mercury Spacecraft

3.12.5.3

ABORT SEQUENCE OFF-THE-PAD AND PRIOR TO TOWER SEPARATION -
(Continued)

2. Provide an interlock for the input of the maximum altitude sensor (time versus time computer). The maximum altitude sensor (Drawing No. 45-87708) shall compute a time delay for abort tower separation versus real time beginning at time zero. This delay shall permit the spacecraft to reach a safe dynamic pressure before jettisoning the escape tower. The time delay (ΔT) for tower separation with relation to time of abort (T_A) after time zero, shall be as follows:

$$\Delta T, \text{ Sec.} = 0.1855 T_A + 7.0 \qquad 0 \leq T_A \leq 62.0$$

$$\Delta T, \text{ Sec.} = 1.6139 T_A - 81.5630 \qquad 62 \leq T_A \leq 81.62$$

$$\Delta T, \text{ Sec.} = 50.165 \qquad T_A \geq 81.62$$

The maximum altitude sensor shall initiate firing of the pylon clamp ring explosive bolts, permitting separation of the clamp ring segments.

- e. Simultaneously with the input to the maximum altitude sensor, the spacecraft-adaptor separation sensor shall energize a power and control relay which shall close upon receipt of a tower separation signal and transmit an abort signal to the tower separation abort interlock relay which shall command the rate damping mode of the ASCS.
- f. The pylon clamp ring shall separate and the tower ring separation sensor shall energize a power and control relay through the tower ring separate interlock relay which, upon receiving a signal from the tower separation abort interlock relay, shall initiate firing of the pylon jettison rocket. Firing of the pylon jettison rocket shall actuate the tower separation sensor, which arms the landing sequence system (see Paragraph 3.17.1) and energizes HF communications.

3.12.5.4

ABORT SEQUENCE AFTER TOWER SEPARATION - Upon receipt of an abort command from sources e. or f. as outlined in Paragraph

3.12.5.2.1, the following shall occur:

- a. The spacecraft ABORT light shall be illuminated and the abort switches energized.

DATE 26 November 1962

ST. LOUIS, MISSOURI

PAGE 65

REVISED _____

REPORT 6603-15A

REVISED _____

~~CONFIDENTIAL~~MODEL Mercury Spacecraft

3.12.5.4

ABORT SEQUENCE AFTER TOWER SEPARATION - (Continued)

- b. The sustainer engine system (Stage 2) shall be shut down.
- c. A power and control relay shall transmit a signal to a thrust cutoff sensor which shall sense sustainer engine thrust decay to 0.20g and energize a 1-second time delay relay. Runout of this relay shall energize the spacecraft ring separation interlock relay through the spacecraft-adapter bolts fire relays. A closure of the latter relays shall fire the spacecraft-adapter clamp ring explosive bolts. Initiation of the explosive bolts shall permit separation of the clamp ring segments. This shall be detected by the adapter ring separation sensor which, if tower separation has occurred, shall transmit a firing signal to the posigrade rockets. Firing of the posigrade rockets shall provide a velocity increase of 28 feet per second for separation of the spacecraft from the adapter-sustainer complex.
- d. The spacecraft-adapter separation sensor shall arm the satellite clock, which shall receive a reset command from the ground or by the astronaut to initiate the normal retrograde sequence as defined in Paragraph 3.12.5.1, Subparagraphs d4, e, and f.

~~CONFIDENTIAL~~

DATE 26 NOVEMBER 1962

REVISED
REVISED

PAGE 66

REPORT 6603-15A

MODEL MERCURY SPACECRAFT

CONFIDENTIAL

FUNCTIONAL PROFILE

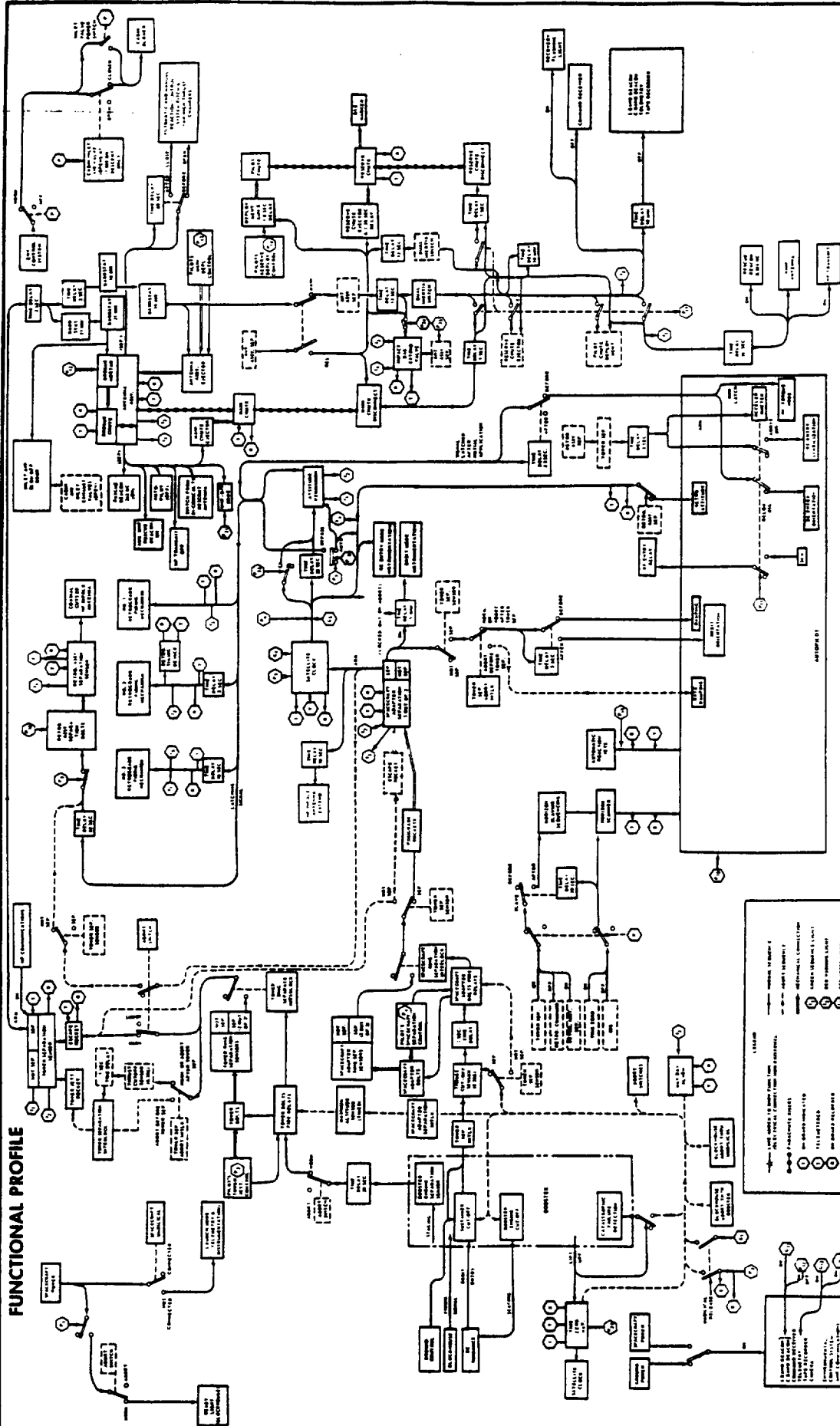


FIGURE 6

CONFIDENTIAL

DATE 26 November 1962

ST. LOUIS, MISSOURI

PAGE

67

REVISED

REPORT

6603-15A

REVISED

~~CONFIDENTIAL~~

MODEL

Mercury Spacecraft

3.13

ELECTRICAL POWER SUPPLY SYSTEM - The electrical power supply system shall consist of six batteries which comprise the main, standby and isolated power supplies. Inverters shall be used for conversion of D.C. power to A.C. power. All batteries shall have individual diode reverse-current protection for prevention of unnecessary power consumption because of a weak or faulty battery. Each battery shall be sealed at sea level pressure to withstand a pressure of 14.7 psi both internally and externally, and shall have a pressure relief valve for maintaining internal pressure between 0 psi and 14.7 psi as required. The batteries shall be vented for release of gas only with vent lines passing through the large pressure bulkhead and terminating in the spacecraft skin between the bulkhead and the heat shield such that the gas vents overboard. Voltage monitoring shall be provided by the voltmeters located on the main instrument panel. The main and standby batteries listed below shall be capable of providing power requirements for the mission as defined in Paragraph 1.1.1. The D.C. power control system shall be as depicted in Figures 7a and 7b, Pages 70 and 71.

3.13.1

MAIN POWER SUPPLY - The main power supply shall consist of three 3000 watt-hour silver-zinc batteries (Drawing No. 45-79707) (see Appendix I-C, Item 4 for electrical components). Terminal voltage of these batteries shall average approximately 24 volts with a maximum of 29.6 volts and a minimum of 18 volts. Taps shall be provided at 6, 12 and 18-volt levels. The main batteries shall be wired in parallel with power inserted or withdrawn from the parallel circuit by an adjacent ON-OFF switch.

3.13.2

STANDBY POWER - The standby power supply (Drawing No. 45-79707) shall consist of two 3000 watt-hour silver-zinc batteries identical to those in the main power supply. The standby batteries shall be paralleled with the main batteries throughout the mission. Selection of standby battery operation shall be made by a switch provided on the main instrument panel (see Paragraph 3.8.9.6). When the astronaut places the switch in the ON position, standby power shall be inserted into the main bus. The standby batteries shall also have sufficient capacity to provide a power source for the auxiliary UHF and HF rescue beacons.

3.13.2.1

ISOLATED POWER - The isolated power supply (Drawing No. 45-79707) shall consist of one 1500 watt-hour silver-zinc battery similar to those in the main and standby power supplies. The isolated battery system shall have sufficient capacity to provide power to the pyrotechnic-actuated devices (see Paragraph 3.20). The isolated battery shall supply power to the audio bus if the AUDIO BUS switch is placed in the EMERG position by the astronaut. Isolated battery power shall be inserted into the standby battery circuit if the ISOLATED BATTERY switch is placed in the STANDBY position by the astronaut. The isolated battery shall also have sufficient capacity for operation of the UHF rescue beacon.

~~CONFIDENTIAL~~

DATE 26 November 1962

ST. LOUIS, MISSOURI

PAGE 68

REVISED _____

REPORT 6603-15A

REVISED _____

~~CONFIDENTIAL~~MODEL Mercury Spacecraft

3.13.3 A.C. POWER SYSTEM - The A.C. power system shall consist of two main and one standby static inverters and filters for conversion of 24-volt D.C. power to 115-volt, single-phase, 400-cycle A.C. power. Ambient air in the vicinity of the inverters shall be drawn through a screened duct installation (Drawing No. 45-83144) to the cabin fan intake. The cabin fan shall force the air through the cabin heat exchanger to assist in dissipating heat resulting from inverter operation.

3.13.3.1 MAIN A.C. POWER SYSTEM - The main A.C. power system shall consist of one 250 volt-ampere (VA) static inverter and one 150 VA static inverter (Drawing No. 45-79709). The 250 VA inverter shall supply A.C. power to the ASCS and horizon scanners. The 150 VA inverter shall supply A.C. power to the environmental control system fans, rate indicating system, and cabin lights. The inverters shall supply A.C. power as specified during the launch, orbit and re-entry phases of the mission as described in Paragraph 1.1.1.

3.13.3.2 STANDBY A.C. POWER - The standby A.C. power system shall consist of one 250 VA static inverter (Drawing No. 45-79709). The standby inverter shall supply A.C. power to either or both the ASCS bus and fans bus, dependent upon the position of the ASCS A.C. BUS switch and the FANS A.C. BUS switch. If both switches have been placed in the NORM position and compound main inverter failure occurs, A.C. power shall be supplied to both the ASCS bus and fans bus by the standby inverter. Upon failure of either of the main inverters, the appropriate circuit shall be de-energized and the standby inverter shall supply A.C. power to the equipment formerly powered by the main inverter. If both switches have been placed in the STBY position, A.C. power shall be supplied to both the ASCS bus and fans bus by the standby inverter. Either the ASCS A.C. bus or the fans A.C. bus may be removed from the A.C. circuit by placing their respective switches in the OFF position. This shall remove either D.C. power to the respective main inverters or the A.C. output of the standby inverter, dependent upon the source of the A.C. power.

3.13.4 ELECTRICAL CONNECTIONS - Design of the electrical system shall be such that there shall be no exposed electrical connections within the spacecraft which would permit shorting by corrosive atmosphere and/or floating debris.

3.13.4.1 UMBILICAL CONNECTIONS - In order to maintain a fully-charged condition on the batteries and to provide power for ground testing of various systems within the spacecraft, external power shall be supplied to the spacecraft prior to launching through an umbilical plug and disconnect assembly (Drawing No. 45-79723). This plug shall be attached to the spacecraft mating receptacle through the open umbilical door. The

DATE 26 November 1962

MCDONNELL

ST. LOUIS, MISSOURI

PAGE 69

REVISED _____

REPORT 6603-15A

REVISED _____

CONFIDENTIAL

MODEL Mercury Spacecraft

3.13.4.1 UMBILICAL CONNECTIONS - (Continued)

umbilical coupling device shall afford a secure and positive spacecraft connection which shall be capable of release both electrically by a solenoid release mechanism and manually by a lanyard release. It shall be the function of the umbilical connection to provide for the transfer of Freon 114 to the spacecraft during prelaunch operations.

CONFIDENTIAL

CONFIDENTIAL

D.C. POWER CONTROL SYSTEM

FUNCTION	DESCRIPTION	WIRING	TEST	REMARKS
1	1. MAIN BATTERY (1000 AMP) - 28 VOLTS	1. MAIN BATTERY (1000 AMP) - 28 VOLTS	1. MAIN BATTERY (1000 AMP) - 28 VOLTS	1. MAIN BATTERY (1000 AMP) - 28 VOLTS
2	2. MAIN BATTERY (1000 AMP) - 28 VOLTS	2. MAIN BATTERY (1000 AMP) - 28 VOLTS	2. MAIN BATTERY (1000 AMP) - 28 VOLTS	2. MAIN BATTERY (1000 AMP) - 28 VOLTS
3	3. MAIN BATTERY (1000 AMP) - 28 VOLTS	3. MAIN BATTERY (1000 AMP) - 28 VOLTS	3. MAIN BATTERY (1000 AMP) - 28 VOLTS	3. MAIN BATTERY (1000 AMP) - 28 VOLTS
4	4. MAIN BATTERY (1000 AMP) - 28 VOLTS	4. MAIN BATTERY (1000 AMP) - 28 VOLTS	4. MAIN BATTERY (1000 AMP) - 28 VOLTS	4. MAIN BATTERY (1000 AMP) - 28 VOLTS
5	5. MAIN BATTERY (1000 AMP) - 28 VOLTS	5. MAIN BATTERY (1000 AMP) - 28 VOLTS	5. MAIN BATTERY (1000 AMP) - 28 VOLTS	5. MAIN BATTERY (1000 AMP) - 28 VOLTS
6	6. MAIN BATTERY (1000 AMP) - 28 VOLTS	6. MAIN BATTERY (1000 AMP) - 28 VOLTS	6. MAIN BATTERY (1000 AMP) - 28 VOLTS	6. MAIN BATTERY (1000 AMP) - 28 VOLTS
7	7. MAIN BATTERY (1000 AMP) - 28 VOLTS	7. MAIN BATTERY (1000 AMP) - 28 VOLTS	7. MAIN BATTERY (1000 AMP) - 28 VOLTS	7. MAIN BATTERY (1000 AMP) - 28 VOLTS
8	8. MAIN BATTERY (1000 AMP) - 28 VOLTS	8. MAIN BATTERY (1000 AMP) - 28 VOLTS	8. MAIN BATTERY (1000 AMP) - 28 VOLTS	8. MAIN BATTERY (1000 AMP) - 28 VOLTS
9	9. MAIN BATTERY (1000 AMP) - 28 VOLTS	9. MAIN BATTERY (1000 AMP) - 28 VOLTS	9. MAIN BATTERY (1000 AMP) - 28 VOLTS	9. MAIN BATTERY (1000 AMP) - 28 VOLTS
10	10. MAIN BATTERY (1000 AMP) - 28 VOLTS	10. MAIN BATTERY (1000 AMP) - 28 VOLTS	10. MAIN BATTERY (1000 AMP) - 28 VOLTS	10. MAIN BATTERY (1000 AMP) - 28 VOLTS

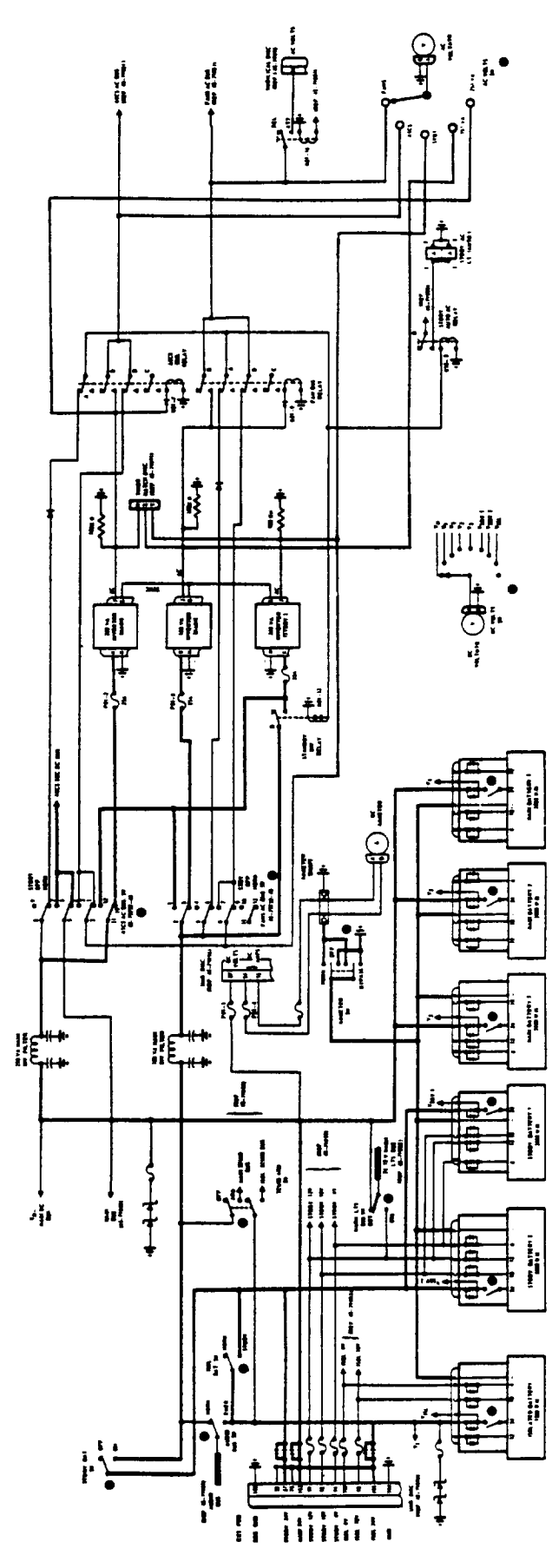


FIGURE 7A

CONFIDENTIAL

CONFIDENTIAL

D.C. POWER CONTROL SYSTEM

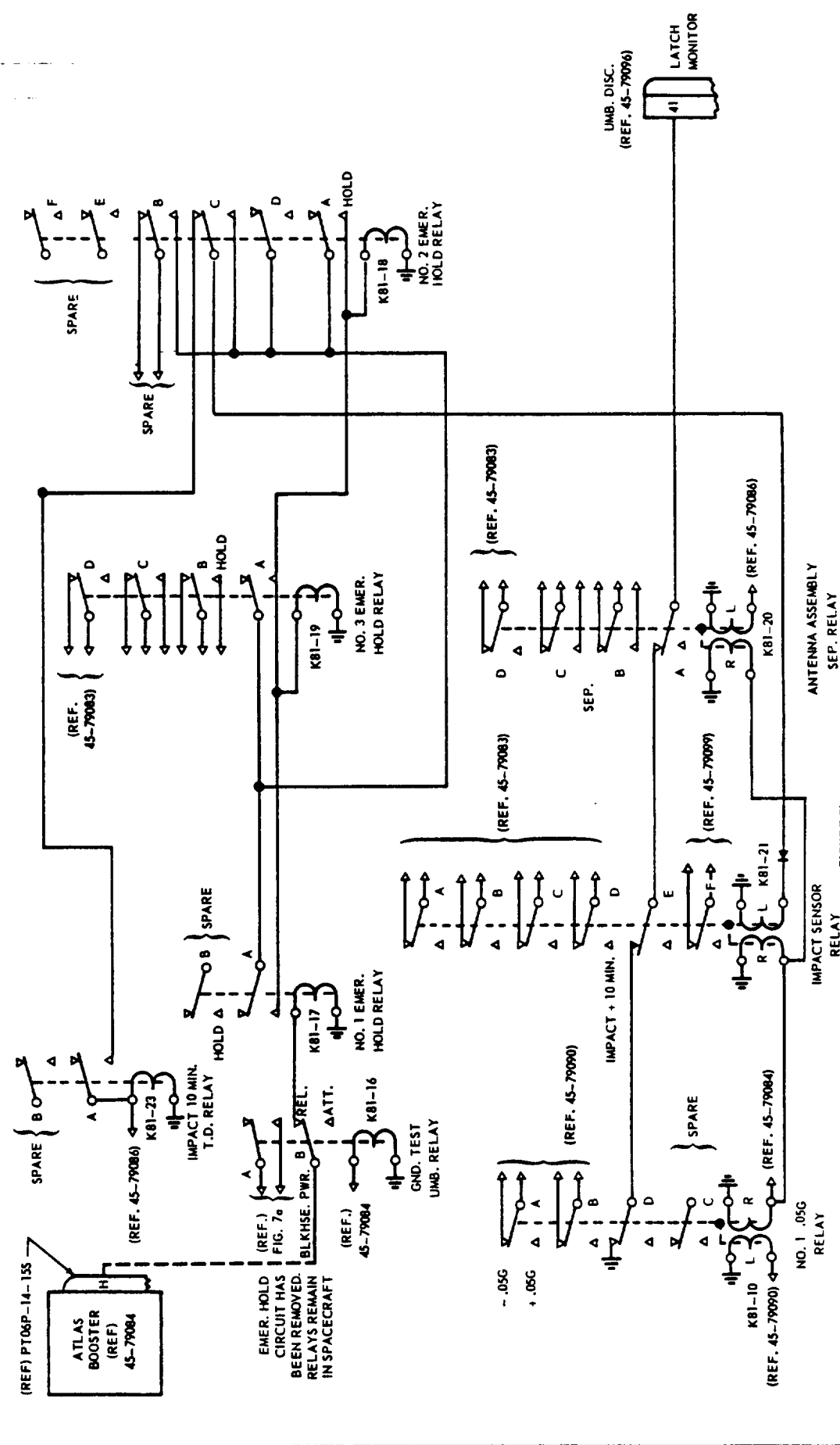


FIGURE 76

CONFIDENTIAL

DATE 26 November 1962

ST. LOUIS, MISSOURI

PAGE 72

REVISED _____

REPORT 6603-15A

REVISED _____

~~CONFIDENTIAL~~MODEL Mercury Spacecraft

3.14 COMMUNICATIONS SYSTEM - The communications system provided aboard the Mercury Spacecraft shall be compatible with the world-wide ground station complex. Wherever practicable, existing systems of telemetry, tracking, and voice communications shall be used. The following systems of communication (Drawing No. 45-85700) shall be provided aboard the spacecraft:

- a. Two-way HF/UHF orbital voice communication
- b. Command receiver - ground to spacecraft
- c. Telemetry equipment - spacecraft to ground
- d. C-Band radar tracking beacon
- e. S-Band radar tracking beacon
- f. HF/UHF - Rescue beacon
- g. UHF auxiliary rescue beacon

3.14.1 TWO-WAY HF/UHF ORBITAL VOICE COMMUNICATION - The two-way orbital voice communication system shall consist of an amplitude-modulated HF transmitter-receiver and UHF transmitter-receiver. The HF transmitter-receiver shall operate on a 15.016-megacycle frequency, have a 5.0-watt RF output and a sensitivity such that not more than 5 microvolts shall be required for 10 db signal-to-noise ratio, and shall contain provisions for 12 db level speech clipping. The UHF transmitter-receiver shall operate on 296.8 megacycles and shall have a 3.5 microvolt sensitivity for 10 db signal-to-noise ratio and contain provisions for 12 db level speech clipping. The UHF unit as described herein shall have a 0.5-watt power output and drive a 2.0-watt amplifier. The UHF unit shall be automatically energized at antenna assembly jettison and shall transmit continuously for direction finding in the recovery phase.

3.14.1.1 AUDIO CENTER - The audio center shall contain a voice-controlled transmit-receive relay (VOX) and associated circuitry to activate the selected transmitter-receiver or the tape recorder. Provisions shall be incorporated to permit the astronaut to adjust the threshold level of the VOX. The unit shall also contain transistorized audio amplifiers for microphone and headphone circuits, a voice filter for the command receiver, and associated relays and switches. This unit shall be energized when the VOX FWR switch is placed in the RECORD or TRANSMIT position. When the VOX FWR switch is placed in the OFF or RECORD position, the astronaut must depress the "push-to-talk" microphone button (see Paragraph 3.8.8.2.2) to transmit via the voice communication unit selected. With the switch in RECORD position, the tape recorder shall be activated through the voice controlled relay.

DATE 26 November 1962

ST. LOUIS, MISSOURI

PAGE 73

REVISED _____

REPORT 6603-15A

REVISED _____

CONFIDENTIALMODEL Mercury Spacecraft

3.14.1.2 ASTRONAUT'S HEADSET/MICROPHONE ASSEMBLIES - Two headset/microphone assemblies shall be available for astronaut use. One assembly shall be contained in the astronaut's helmet, and shall be connected to the communications system through the applicable suit connector. Transmitter keying shall be accomplished by manual and/or automatic circuits in the spacecraft. This assembly shall be used from pre-launch through landing. The second headset/microphone assembly shall have a push-to-talk switch and approximately 30 feet of cable, and shall be used for post-egress communications. Immediately prior to egress, the astronaut shall disconnect the applicable suit connector and connect the post-egress headset/microphone assembly to the spacecraft communications system connector.

3.14.2 COMMAND RECEIVER SYSTEM - A frequency modulated transistorized command receiver, similar to the AN/DRW-13 receiver, and a command decoder shall be provided. The command system shall provide a total of twenty decoder outputs, consisting of ten channels in the receiver and ten channels in the decoder. The command receiver shall operate on a frequency of 414.0 megacycles and shall be compatible with FRW-2 ground command transmitters. The receiver shall provide simultaneous operation of five decoder channels, with a sensitivity such that not more than five microvolts input signal is required from 20 degrees centigrade through 30 degrees centigrade with a deviation of + 60 kc per channel. From zero degrees centigrade through 20 degrees centigrade and from 30 degrees centigrade through 71 degrees centigrade, the sensitivity shall be such that not more than seven microvolts is required with a deviation of + 60 kc per channel. The command receiver system shall accept and decode the following commands (parenthetical numbers indicate symbols shown on the Functional Profile, Figure 6, Page 66): abort (G-1), satellite clock reset (G-4), retrograde rocket fire (G-5), C-Band beacon on (G-11), S-Band beacon on (G-11), and telemetry transmitter on (G-12). Verification of commands shall be telemetered. Receipt of a retrograde rocket firing reset command shall be indicated by an amber warning light located on the warning light panel (see Paragraph 3.8.9.4.1). It shall be possible to use the command receiver for emergency voice reception.

3.14.3 TELEMETRY - Telemetry equipment provided shall be a telemetry transmitter and power supply. Data shall be telemetered to ground stations to provide necessary real time information concerning the astronaut, spacecraft, and life support system. Telemetry shall afford back-up in the event that on-board data are not retrieved. The telemetry system shall remain energized for ten minutes after impact (see Paragraph 3.17.3.4).

3.14.3.1 TELEMETRY TRANSMITTER - The telemetry transmitter shall operate on 226.2 megacycles with a transmitter power output of 3.3 watts. This unit shall transmit scientific and aeromedical information by means of seven IRIG standard FM subcarriers, one containing PAM modulation (10.361 kc subcarrier) which shall provide 88 data samples plus two sync

DATE 26 November 1962

ST. LOUIS, MISSOURI

PAGE 74

REVISED _____

REPORT 6603-15A

REVISED _____

MODEL Mercury Spacecraft~~CONFIDENTIAL~~

3.14.3.1 TELEMETRY TRANSMITTER - (Continued)

pulses for reference, each measured 1-1/4 times per second. The unit shall be capable of continuous operation for the duration of the mission. Upon interrogation by ground command, the transmitter shall operate for a period of six minutes from an input signal supplied by Section B of the data programmer (see Paragraph 3.15.4).

3.14.3.2 TELEMETRY POWER SUPPLY - A transistorized power supply shall be provided for the telemetry transmitter. The power supply shall operate from spacecraft D.C. power.

3.14.4 TRANSPONDERS AND BEACONS

3.14.4.1 C-BAND BEACON - The C-Band radar tracking beacon shall be compatible with the FPS-16 radar system. The C-Band beacon transponder shall consist of a transistorized receiver operating on a 5480-megacycle frequency and a transistorized transmitter (except for its magnetron) operating on a 5555-megacycle frequency. The transponder RF input shall be double-pulse coded and shall provide sufficient receiver sensitivity to normally attain an effective line-of-sight range of 700 nautical miles at orbital altitude. Power output of this unit shall be 375 watts peak. The C-Band beacon shall incorporate a lockout feature which shall prevent interrogation during the beacon power supply recovery time.

3.14.4.2 S-BAND BEACON - The S-Band radar tracking beacon shall be compatible with the SCR-584 Mod. II radar and the VERLORT long range radar. The S-Band beacon transponder shall consist of a transistorized receiver operating on a 2840-megacycle frequency and a transmitter operating on a 2910-megacycle frequency. The transponder input shall be double-pulse coded and shall provide sufficient receiver sensitivity to normally attain an effective line-of-sight range of 700 nautical miles at orbital altitude. Power output of this unit shall be 1000 watts peak. The S-Band beacon shall incorporate a lockout feature which shall prevent interrogation during the beacon power supply recovery time.

3.14.4.3 RECOVERY AIDS

3.14.4.3.1 HF/UHF RESCUE BEACON - The rescue beacon shall facilitate recovery operation. This unit shall be an HF/UHF MCW/pulse modulated unit containing a 243-megacycle SARAH rescue beacon and the 8.364-megacycle MCW portion of the SEASAVE beacon. The HF beacon shall have a transmitted power output of 1.0 watt and the UHF beacon shall have a transmitted peak power of 7.5 watts. The UHF portion of the rescue beacon shall have an effective line-of-sight range of at least 100 nautical miles.

3.14.4.3.2 UHF AUXILIARY RESCUE BEACON - The UHF auxiliary rescue (Super SARAH) beacon shall be primarily for establishing contact with airborne search vehicles and shall have a line-of-sight range of at least 100 nautical miles. This unit shall consist of a UHF transmitter operating on 243 mc. The beacon shall receive its power from the 3000 watt-hour

~~CONFIDENTIAL~~

DATE 26 November 1962

ST. LOUIS, MISSOURI

PAGE

75

REVISED

REPORT

6603-15A

REVISED

MODEL

Mercury Spacecraft~~CONFIDENTIAL~~

3.14.4.3.2 UHF AUXILIARY RESCUE BEACON - (Continued)

standby batteries through the standby bus and shall be capable of transmitting peak power of 90 watts with an input of 6.2 volts D.C. for a period of twenty-four hours. The unit shall be energized at bicone antenna assembly separation. Provisions shall be incorporated to prevent the auxiliary beacon from transmitting into the folded antenna (see Paragraph 3.14.6.6) during testing.

3.14.5 COMMUNICATIONS CONTROL PANEL - A communications control panel shall be provided in the lower right-hand corner of the instrument panel. The control panel shall contain audio mixing circuitry, volume controls for the HF, UHF and emergency command voice channels, a Morse code keying button for telemetry transmission control, and a direction-finding switch which shall enable the astronaut to use the UHF transmitter-receiver for normal transmission and reception. The volume controls shall be vertically mounted. It shall be possible for the astronaut to rotate the volume controls with a fully inflated pressure suit by gripping the edge of the instrument panel with his fingers and rotating the control with his thumb. A "push-to-talk" microphone button shall be provided on the abort handle (see Paragraph 3.8.8.2.2). This button must be used by the astronaut for transmission via the selected communications unit when the VOX FWR switch is in the OFF or RECORD position. The communications audio control shall receive aural alarm signal inputs from the warning system tone generator (see Paragraph 3.8.9.4.1). The aural alarms shall result in a steady tone audible through the astronaut's headset.

3.14.6 ANTENNAS - Antennas shall be provided for all communication systems. Antennas for each system shall provide the required coverage for each phase of the mission. Recovery system antennas shall be mounted in such a manner as to prevent loss of signal from water or salt spray. Multiplexers, diplexers, coaxial switches and miscellaneous RF components shall be utilized where necessary to limit the number of antennas. Antenna and cable losses shall be minimized consistent with all other spacecraft requirements. Provisions shall be incorporated for selective HF transmission through the bicone, dipole, or whip antenna. Selection is accomplished by means of an HF ANTENNA SELECT switch located on the BY 4.00 equipment shelf to the astronaut's right.

3.14.6.1 C- AND S-BAND ANTENNA - A C- and S-Band antenna system capable of operation during all phases of the mission shall be provided. This antenna system shall consist of three flush helices for each of the two beacons to provide omnidirectional coverage, with a power divider for each of the two beacons and matched cabling from the power dividers to the antennas. A phase shifter shall be installed in one cable to improve C-Band radar reception during spacecraft turn-around. Each antenna shall be capable of separate or simultaneous operation. The C- and S-Band antennas shall be externally located in a band around the spacecraft conical section near the junction of the cylindrical recovery compartment.

DATE 26 November 1962

MCDONNELL

ST. LOUIS, MISSOURI

PAGE 76

REVISED _____

REPORT 6603-15A

REVISED _____

MODEL Mercury Spacecraft

CONFIDENTIAL

3.14.6.2 BICONE ANTENNA - The bicone antenna shall operate during pre-launch, launch, orbit, and re-entry phases of the mission. This antenna shall be incorporated in, and jettisoned with, the communications antenna assembly (see Paragraph 3.5.6). Through a multiplexing system, the HF and UHF orbital voice communications, the command receiver and the telemetry transmitter shall utilize the bicone antenna.

3.14.6.2.1 MULTIPLEXER - A multiplexer shall be provided to permit simultaneous or individual operation of HF/UHF transmitter-receivers (excluding DF mode of UHF), telemetry transmitter, and the command receiver in conjunction with the bicone antenna. The multiplexer shall be compatible with the UHF descent antenna for use after jettison of the bicone antenna. This unit shall be located in the spacecraft pressurized area.

3.14.6.3 UHF DESCENT ANTENNA - A wire butterfly-type descent antenna shall be provided for supplying omnidirectional coverage. This antenna shall permit simultaneous operation of the telemetry transmitter, UHF rescue beacon, and command receiver. The descent antenna shall be located on the spacecraft parachute housing structure, and shall be tethered until after main chute deployment to prevent possible damage from the chute risers. This antenna shall be spring-loaded and shall extend into the erect operating position 16 seconds after antenna assembly separation by means of a lanyard-initiated reefing cutter which shall sever the tie-down cord upon actuation.

3.14.6.4 HF RESCUE ANTENNA SYSTEM - A telescopic whip-type antenna shall be provided for use with the HF rescue beacon and the HF voice transmitter/receiver. This antenna shall be stowed in the recovery compartment and shall be automatically extended by the landing system dual inertia switch (see Paragraph 3.17.3.4). The antenna shall extend to a nominal length of 16 feet when in operating position.

3.14.6.5 HF DIPLEXER - An HF diplexer shall be provided for use during the recovery phase to connect the output of the HF portion of the HF/UHF rescue beacon and the HF voice transmitter/receiver to the HF rescue (whip) antenna. The diplexer shall be located in the spacecraft pressurized area.

3.14.6.6 UHF AUXILIARY RESCUE BEACON ANTENNA - An independent semi-rigid steel ribbon-type antenna shall be provided for operation of the Super SARAH beacon only. This antenna shall be retained in a folded position by the antenna assembly and released for erection at antenna jettison.

3.14.6.7 HF DIPOLE ANTENNA - The HF dipole antenna shall consist of two dipole elements mounted on opposite sides of the retrograde package. The elements shall be constructed of thin metal tape, heat-treated to assume tubular form when deployed. When stowed, the elements shall be

CONFIDENTIAL

DATE 26 November 1962

MCDONNELL

ST. LOUIS, MISSOURI

PAGE 77

REVISED _____

REPORT 6603-15A

REVISED _____

CONFIDENTIAL

MODEL Mercury Spacecraft

3.14.6.7 HF DIPOLE ANTENNA - (Continued)

wound on spools as flat tape. The spools shall be held in the stowed position by squib-disconnected retaining straps. At spacecraft separation plus 10 seconds, antenna extension shall be initiated. Upon unwinding from the spools, the metal tape shall return to its original tubular form. The astronaut shall manually select the DIPOLE ANT position on the HF ANTENNA SELECT switch (see Paragraph 3.14.6). At retrograde package separation, the antenna coax cable shall be severed by a squib-actuated cutter. The antenna shall be jettisoned with the retrograde package.

3.14.7 COAXIAL SWITCHES - A motor-operated coaxial switch shall be provided for switching from the bicone antenna to the UHF descent antenna upon main parachute deployment. A manual three-position rotary switch shall be used for switching the HF voice transceiver to the bicone, dipole, or whip antenna. (See Paragraph 3.14.6.)

3.14.8 COAXIAL CABLES AND CONNECTORS - Raytherm Type 12-080s, 12-233 or 12-234 coaxial cable shall be used for all interconnections between the electronic equipment and antennas. Coaxial connectors shall be of the miniature type.

3.14.9 BICONE ISOLATOR - A bicone isolator shall be installed at the base of the communications antenna assembly to permit the routing of electrical cables through the faces of the bicone antenna without detrimental interaction between electrical signals in the wiring and antenna elements. The bicone isolator shall be mounted on, and compatible with, antenna assembly structure.

DATE 26 November 1962

MCDONNELL

ST. LOUIS, MISSOURI

PAGE 78

REVISED _____

REPORT 6603-15A

REVISED _____

~~CONFIDENTIAL~~

MODEL Mercury Spacecraft

3.15 RECORDING EQUIPMENT - Recording equipment meeting the requirements of Specification MIL-E-5272A-1 and MIL-E-5400B(ASG) shall be comprised of equipment specified in the following paragraphs. A satisfactory isolation technique shall be employed to avoid crosstalk or interference between systems being fed from common pickups. Methods of data recording within the spacecraft shall be as noted below, and as depicted in Figure 8a, Page 82. In addition, telemetry equipment for transmitting data from the spacecraft to ground stations shall be provided as specified in Paragraph 3.14.3 and subparagraphs.

- a. Photographic recording of astronaut.
- b. Tape recording of data and voice.
- c. Photographic recording of cosmic ray collisions.
- d. Special instrumentation.

3.15.1 UTILITY CAMERA - A 16 mm motor-driven manually-operated camera (Drawing No. 45-88121) shall be provided. The camera shall be powered by a self-contained battery and operate at 6 frames per second. Six film magazines shall be provided, each magazine containing 120 feet of film. The camera shall be equipped with three lenses: wide angle, normal, and telephoto. During launch and re-entry, the camera shall be mounted in the main instrument panel for observing the motions and appearance of the astronaut. A mount shall also be provided at the upper right of the inner window assembly. (See Paragraph 3.5.5.1.)

3.15.2 TAPE RECORDER - A tape recorder (Drawing No. 45-88707) shall be provided for permanent data storage. The recorder shall function periodically throughout the mission and for 10 minutes after impact for recording of astronaut comments and observations. With the RECORDING switch (see Paragraph 3.8.9.6) in PROGRAM position, continuous operation shall be programmed from liftoff until five minutes after spacecraft

DATE 26 November 1962**MCDONNELL**

ST. LOUIS, MISSOURI

PAGE 79

REVISED _____

REPORT 6603-15A

REVISED _____

CONFIDENTIALMODEL Mercury Spacecraft

3.15.2 TAPE RECORDER - (Continued)

separation and from 30 seconds prior to retrograde to ten minutes after impact. During the orbital phase of the mission, the recorder shall be energized for one minute in each ten-minute period by signals from Section "A" of the programmer (see Paragraph 3.15.4). In addition, continuous operation may be manually selected by the astronaut by means of the RECORDING switch. This switch may also be used to de-energize the recorder in the event power conservation measures become necessary. The tape recorder shall be controlled by the voice-controlled relay circuit in the audio center (see Paragraph 3.14.1.1) when the VOX PWR switch is in RECORD position. A green indicator light below the selector switch shall be energized when the tape recorder is on (see Paragraph 3.8.9.5). All voice messages sent to ground stations by the astronaut while the tape recorder is in operation shall be recorded. The tape recorder shall be compatible with the pulse duration modulation system, voltage-controlled subcarrier oscillators (VCO) and direct recording media. This unit shall have seven heads for recording data at a tape speed of 1-7/8 ips. Tape capacity shall be 6250 feet of 1/2-inch .83-mil mylar-base tape. A limit switch shall be provided for interrupting power to the recorder in event of tape breakage. Recording tracks utilized shall be as follows:

Track No. 2 - Direct Recording - VCO Output

Track No. 3 - Direct Recording of UHF voice below 3125 cps

Track No. 4 - Pulse Recording - Differentiated PDM signal from low-level commutator - keyer unit

Track No. 5 - Pulse Recording - composite PDM signal from high-level commutator-keyer unit

Track No. 6 - Direct Recording - VCO Output

3.15.2.1 COMMUTATED DATA RECORDING - A commutator-keyer-record amplifier unit (Drawing No. 45-88728) shall be provided. This unit shall be capable of integrating 88 D.C. inputs from the various transducers depicted in Figure 8a, Page 82, plus two internally-generated synchronizing pulses, into a continuous 90 x 1-1/4 standard IRIG signal wave train. Outputs shall be compatible with the on-board tape recorder and telemetry systems.

The commutator portion of the unit shall receive D.C. inputs as described above and shall provide a continuous 112-1/2-pulse-per-second pulse amplitude modulation (PAM) signal output. The PAM signal shall be simultaneously delivered to a converter section and a gating circuit within the unit. The converter section shall provide a pulse duration modulation (PDM) signal which, after amplification, is capable of driving a recording

DATE 26 November 1962**MCDONNELL**

ST. LOUIS, MISSOURI

PAGE 80

REVISED _____

REPORT 6603-15A

REVISED _____

~~CONFIDENTIAL~~MODEL Mercury Spacecraft

3.15.2.1 COMMUTATED DATA RECORDING - (Continued)

head in the on-board tape recorder. The gating circuit shall serve as an introduction point for the synchronizing pulses and shall reduce the duty cycle of the PAM signal to a duration suitable for application to the 10.361 kc VCO's. The telemetered signal from these VCO's shall be suitable for use in ground station automatic decommutation equipment. The unit shall contain circuitry which is capable of providing required operating voltages from spacecraft power.

3.15.2.1.1 LOW-LEVEL COMMUTATOR - A low-level commutator-keyer-record amplifier, furnished by NASA, is provided for use with the special instrumentation system described in Paragraph 3.15.7.

3.15.3 COSMIC RAY FILM PACK - Provisions for installation of four photographic recorders of cosmic ray collisions shall be incorporated in the spacecraft. The recorders shall be furnished by NASA and shall be installed at the launch site (see Appendix I-A).

3.15.4 DATA PROGRAMMER - A data programmer (Drawing No. 45-88710) shall be provided. The programmer shall consist of Sections A and B. Section A shall program operation of the water extractor at a rate of 30 seconds per each 30 minutes; tape recorder operation at a rate of one minute per each ten minutes; gyro slaving to the horizon scanners at a rate of 8.5 minutes per each 30 minutes (capability only); and R-cal and Z-cal signals at a rate of 15 seconds per each 60 minutes. Upon receipt of appropriate command signals from the decoder (see Paragraph 3.14.2), Section B shall provide a 6-minute signal for operation of the telemetry transmitter; a 15-second signal for R-cal, and a 15-second signal for Z-cal. Section B shall be capable of recycle in 5 seconds with a continuous input signal or upon receipt of a new command signal.

3.15.5 VOLTAGE CONTROLLED SUBCARRIER OSCILLATORS - Voltage-controlled subcarrier oscillators (VCO's) in accordance with Appendix I-C shall be provided. The VCO's shall receive inputs from the various sources shown in Figure 8a, Page 82, and, in conjunction with a resistor assembly and an isolation amplifier (see Paragraph 3.15.6), shall provide input signals for the telemetry transmitter, tape recorder, and hard-line circuit.

3.15.5.1 REFERENCE OSCILLATOR - A 3000 cps fixed-frequency oscillator in accordance with Appendix I-C, shall provide a reference signal for monitoring tape recorder wow and flutter.

3.15.6 ISOLATION AMPLIFIER - A dual-section isolation amplifier assembly (Drawing No. 45-88234) shall be provided. The sections shall amplify VCO output to the hard-line circuit and incorporate provisions for adjustment of the signal level applied to the telemetry transmitter and Tracks 2 and 6 of the tape recorder.

~~CONFIDENTIAL~~

DATE 26 November 1962

MCDONNELL

ST. LOUIS, MISSOURI

PAGE 81

REVISED _____

REPORT 6603-15A

REVISED _____

~~CONFIDENTIAL~~

MODEL Mercury Spacecraft

3.15.7 SPECIAL INSTRUMENTATION - The Special Temperature Instrumentation System shall obtain temperature indications from various areas of the spacecraft, as shown in Figure 8b, Page 83. Thermocouple outputs shall be picked off a low-level commutator and applied to the on-board tape recorder when the TEMPERATURE SURVEY switch on the forward surface of the instrument panel support pedestal is in the NORMAL position. During ground testing, the TEMPERATURE SURVEY switch may be placed in the TEST position for transmission through the 10.361 kc VCO.

~~CONFIDENTIAL~~

DATE 26 NOVEMBER 1962

MCDONNELL

ST. LOUIS, MISSOURI

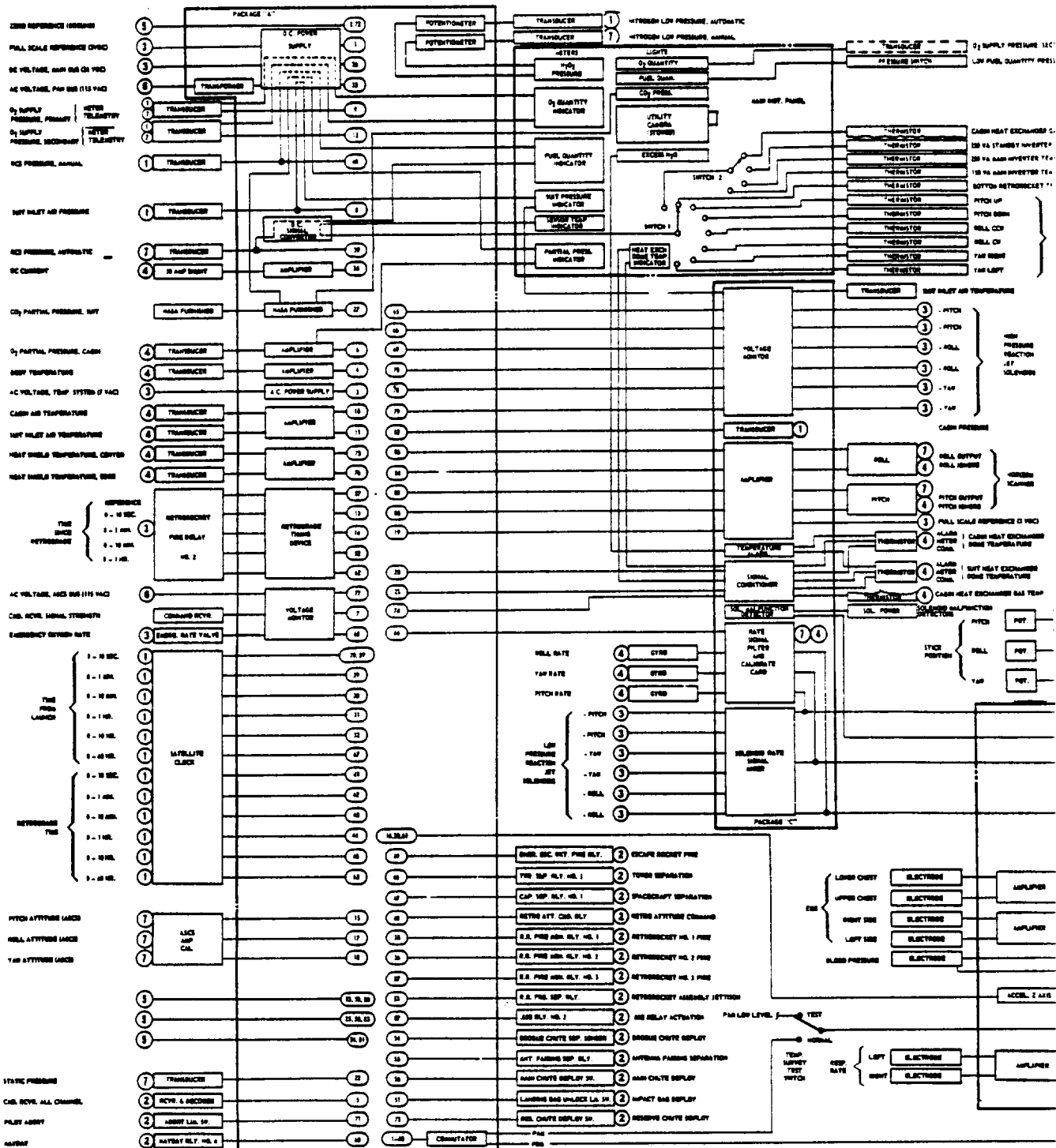
PAGE 82

REVISED

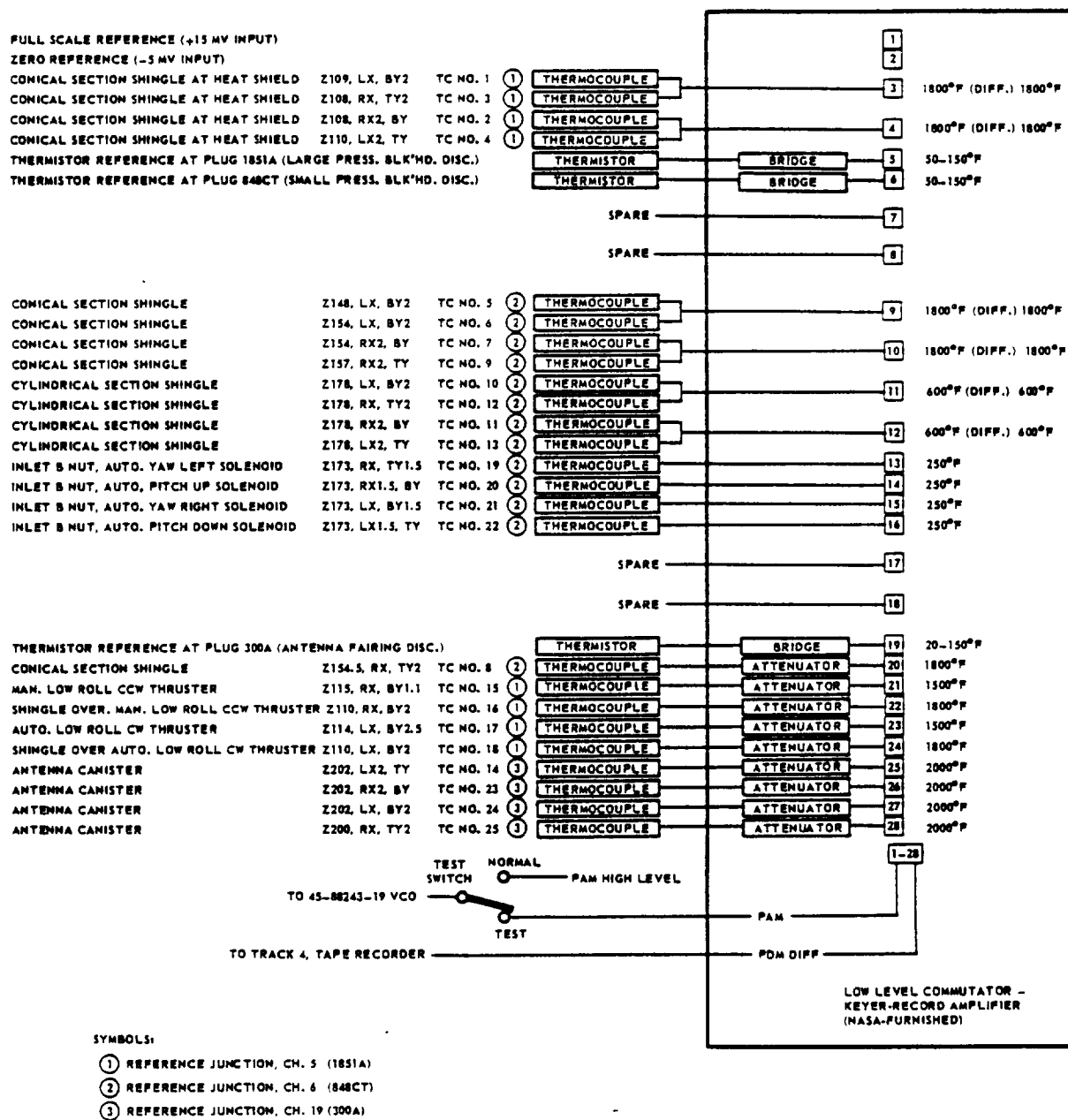
REPORT 6603-15A

REVISED

MODEL MERCURY SPACECRAFT

INSTRUMENTATION SYSTEM**FIGURE 8A**

SPECIAL TEMPERATURE INSTRUMENTATION BLOCK DIAGRAM



DATE 26 November 1962

MCDONNELL

ST. LOUIS, MISSOURI

PAGE 84

REVISED _____

REPORT 6603-15A

REVISED _____

MODEL Mercury Spacecraft

3.16 NAVIGATIONAL AIDS - The astronaut shall be provided with manual navigational aids which shall allow basic navigation without communication or automatic system reference.

3.16.1 NAVIGATIONAL AID KIT - A navigational aid kit (Drawing No. 45-81089) shall contain maps, cards, and a pencil. These navigational aids shall be bound together in a book-like fashion (Drawing No. 45-81087) for simplicity, convenience, and ease of handling. The navigational aid kit shall be mounted to the structure directly below the main instrument panel. All navigational aid kit functions may be performed with inflated pressure suit gloves.

3.16.1.1 STEREOGRAPHIC MAPS - Polar stereographic maps (Drawing No. 45-81706) shall be provided.

3.16.1.2 CARDS - Check, chart, and note cards shall be provided as required by the mission as outlined in Paragraph 1.1.1.

3.16.1.3 PENCIL - A mechanical pencil shall be provided, suitable for writing on clear plastic. A pencil holder and retaining line shall be provided for pencil storage and retention.

3.16.2 OPTICAL ATTITUDE REFERENCE - An illuminated optical system (Drawing No. 45-86049) for spacecraft attitude orientation shall be provided. This system shall be mounted adjacent to the astronaut observation window and shall be capable of stowage during periods of non-use. An integral switch shall illuminate the reticle when the viewing unit is placed in the operational position.

DATE 26 November 1962

ST. LOUIS, MISSOURI

PAGE 85

REVISED _____

REPORT 6603-15A

REVISED _____

MODEL Mercury Spacecraft

3.17 LANDING, POST-LANDING AND SURVIVAL SYSTEMS - A spacecraft landing system shall be provided and shall consist of components tabulated in Appendix I-C herein, Item 10. The landing system (Drawing No. 45-41700) shall include two independent parachute systems, sequencing controls, and post-landing equipment. All parachutes, harnesses and parachute bags as specified herein shall be shipped directly to the launch site where they will be inspected and packed.

3.17.1 LANDING SYSTEM - The landing system shall consist of a primary system comprising a main parachute, a drogue parachute, and associated sequencing controls; and a reserve system comprising a reserve parachute, a pilot parachute, and associated sequencing controls. The landing system sequencing controls shall be armed by the tower separation sensor. For missions aborted between 10,000 feet and 21,000 feet, a minimum time delay of two seconds between escape tower jettison and drogue chute deployment shall provide a sufficient time lapse required for various functional sequences during the abort maneuver. For missions aborted at an altitude below 10,000 feet, an additional time delay of two seconds shall prevent simultaneous actuation of the drogue mortar and the antenna assembly ejector.

3.17.1.1 DROGUE PARACHUTE SYSTEM - A six-foot diameter conical ribbon-type drogue parachute assembly, with a thirty-foot bridle length, shall be provided for adequate dynamic stability and deceleration during the re-entry phase. The drogue chute shall be constructed of cotton, nylon, and dacron materials and shall be designed for a dynamic pressure of 116 pounds per square foot, considering deployment at an altitude of 40,000 feet. The drogue chute shall be stowed in a drogue chute bag. The drogue chute assembly and a mortar sabot shall be located in the drogue mortar tube. At 21,000 feet altitude, dual series-connected barostats (aneroid pressure switches) shall sense static pressure in the recovery compartment and close a switch, completing an electrical circuit to a cartridge squib located under the mortar tube, initiating a powder charge. The pressure shall force the mortar sabot and drogue chute assembly from the mortar tube causing the chute to deploy. The drogue chute shall be attached to the antenna assembly by a 3-riser arrangement and shall be released by jettison of the antenna assembly.

3.17.1.2 MAIN PARACHUTE SYSTEM - The main parachute assembly shall be a 63-foot diameter reefed (12 percent for 4 seconds) ring-sail-type parachute designed to provide a stabilized sinking speed of 30 feet per second at 5,000 feet altitude for a 2,160-pound spacecraft. The main parachute of nylon material shall be designed and constructed to withstand shock loads encountered at the deployment altitude which results in a dynamic pressure of 102.5 PSF. It shall be considered that there has been no velocity decrement occasioned by drogue chute deployment, so that drogue chute failure cases shall be completely covered. The main parachute shall be stowed in the cylindrical recovery compartment (see Paragraph 3.5.1).

DATE 26 November 1962**MCDONNELL**

ST. LOUIS, MISSOURI

PAGE 86

REVISED _____

REPORT 6603-15A

REVISED _____

MODEL Mercury Spacecraft

3.17.1.2 MAIN PARACHUTE SYSTEM - (Continued)

Its deployment bag lanyard shall be connected to the antenna assembly so that upon antenna jettison, the main chute, as it pulls out of the chute pack, shall be deployed. A parachute deployment bridle, fabricated from 750-pound tubular nylon webbing, shall be attached to the apex of the parachute in such a manner that the loads encountered upon parachute deployment shall be distributed symmetrically about the apex. This shall take place at approximately 10,000 feet altitude as sensed by dual series-connected barostats (aneroid pressure switches). The barostats shall complete an electrical firing circuit to the antenna ejector assembly subsequently jettisoning the antenna assembly. Upon separation of the antenna assembly, the main chute ejector gas generator assembly shall be electrically initiated, and shall produce gas for injection into the main parachute ejector bag, which, with the antenna assembly, shall eject the main chute pack from the recovery compartment. As this occurs, the main chute shall pull out of the main chute deployment bag, releasing the antenna assembly, drogue chute, and bag. Separation of the antenna assembly shall energize the 243 mc SARAH rescue beacon and the auxiliary UHF rescue beacon; de-energize the ASCS and HF transmitter; energize the UHF beacon for direction-finding mode; switch from the bicone antenna to the UHF descent antenna; simultaneously energize a 150-second time delay relay and power and control relay which shall open the reaction control system pitch and yaw high level thrust chamber solenoids to expel hydrogen peroxide and, after a 12-second time delay, shall arm the impact sensor (dual inertia switch) and the impact bag extend valve. Gore colors of the main parachute shall be natural and international orange alternately arranged.

3.17.1.3 PILOT PARACHUTE - The pilot parachute shall be a flat circular type, with a 72-inch diameter and a 30-foot bridle length, constructed of nylon cloth, with nylon webbing and cord. The pilot parachute shall be designed for deployment in event of failure of the main parachute. Deployment of the pilot parachute shall be controlled by the astronaut through actuation of the RESERVE override control (P-14) located on the left-hand console. Upon actuation of this control, the main chute disconnect squib cartridge, the pilot chute deployment gun electric squib cartridge, and the reserve chute ejector bag gas generator shall be electrically initiated (provided antenna separation has occurred), and the main charge of the deployment gun shall be mechanically initiated by gas pressure from an initiator. The deployment gun electric squib and the mechanical ignition provisions for the main charge shall each incorporate one-second time delays. The reserve ejector bag gas generator shall incorporate a 1.25-second time delay. After runout of the one-second time delay, the deployment gun main charge shall eject the deployment gun projectile assembly to which the pilot chute bridle assembly shall be attached. The bridle assembly shall be

DATE 26 November 1962

ST. LOUIS, MISSOURI

PAGE 87

REVISED _____

REPORT 6603-15A

REVISED _____

MODEL Mercury Spacecraft~~CONFIDENTIAL~~

3.17.1.3 PILOT PARACHUTE - (Continued)

attached to the projectile assembly on one end and to the pilot chute canopy on the other. Upon extraction of the pilot chute from the reserve chute bag, its lanyard shall pull the bag from the recovery compartment. The reserve chute shall then pull out of the bag, which is permanently attached to the apex of the reserve chute to assist development of a more symmetrical chute deployment.

3.17.1.4 RESERVE PARACHUTE - The reserve parachute assembly shall be a 63-foot diameter reefed ring-sail-type parachute identical in design, construction, and reefing to the main parachute. The reserve parachute shall be stowed in the cylindrical recovery compartment. Its deployment bag shall be attached to the pilot chute lanyard, so that upon deployment of the pilot chute, the reserve chute deployment bag shall be extracted. As the pilot chute deploys, the reserve chute ejector gas generator assembly shall be electrically initiated and shall produce gas for injection into the reserve chute ejector bag which, with the pilot chute, shall extract the reserve chute pack from the recovery compartment. At the time of reserve chute ejection, a fluorescent dye marker package, attached to the spacecraft by a lanyard, shall be ejected. (See Paragraph 3.17.3.1.) In a normal landing sequence where the reserve chute has not been deployed, the reserve chute shall be ejected from the spacecraft through the RESCUE toggle switch (P-15) after the impact sensor (dual inertia switch) has become energized. The reserve chute shall also be ejected after runout of a 10-minute time delay which shall become energized by closure of the impact sensor (dual inertia switch) upon impact. (See Paragraph 3.17.3.4.) This time delay shall bypass the RESCUE toggle switch and shall energize the same circuitry as this switch.

3.17.2 IMPACT SKIRT - The spacecraft shall be equipped with a fiberglass/silicon rubber-impregnated impact skirt (Drawing No. 45-32700). The impact skirt shall be attached to the spacecraft structural assembly by a skirt retainer ring at 120 points and to the spacecraft heat shield at 189 points equally spaced around the heat shield on a radius of approximately 36 inches from the Z axis, (Drawing No. 45-32300) and shall be capable of withstanding landing impact loads for water and earth landings as specified in M.A.C. Report No. 6693. A large pressure bulkhead shield conforming to Drawing No. 45-32290 shall be installed between the large pressure bulkhead and the heat shield (Drawing No. 45-32002), and shall prevent the heat shield from damaging the pressure bulkhead upon landing. The impact skirt shall be capable of extension by both automatic and manual systems.

Automatic extension shall take place 12 seconds after antenna assembly separation, provided the LANDING BAG switch is in AUTO position. At this time, the explosive valves on the heat shield release system shall

DATE 26 November 1962

ST. LOUIS, MISSOURI

PAGE 88

REVISED _____

REPORT 6603-15A

REVISED _____

MODEL Mercury Spacecraft3.17.2 IMPACT SKIRT - (Continued)

be ignited, releasing pressure from the pneumatic tank which shall actuate the heat shield release mechanism, allowing the heat shield to drop down and extend the impact skirt. This allows two landing bag unlock signal limit switches to return to a normal position, which energizes the green LANDING BAG telelight. When the control relay for the landing bag extend valve is energized, a two-second timer shall start simultaneously. If, after two seconds, the limit switches have not returned to a normal position, the LANDING BAG telelight shall illuminate red. The astronaut can then use a parallel circuit to fire the explosive valves by placing the LANDING BAG switch in the MANUAL position. Upon impact, air is forced out of orifices near the bottom of the impact skirt, allowing the spacecraft to settle to a normal attitude within seconds after impact.

3.17.3 POST-LANDING SYSTEM - The post-landing system shall include a fluorescein dye marker package, a shark repellent package, a flashing recovery light, a SOFAR bomb, and inertia switches for actuation of equipment essential to recovery.

3.17.3.1 FLUORESCCEIN DYE MARKER - A fluorescein dye marker packet assembly shall be provided to aid in visual location during the search phase. In a normal landing sequence, the fluorescein dye marker shall be ejected after reserve chute ejection and impact on the water. In a landing where the reserve chute has been deployed, the fluorescein dye marker shall have been ejected with the reserve chute. The fluorescein dye marker shall be packaged in a water soluble container enclosed by a perforated metal can attached to the capsule by a retainer line. Sponge rubber shall be installed around the periphery of the dye marker package to prevent damage to the spacecraft window.

3.17.3.2 SHARK REPELLENT - A shark repellent packet assembly shall be provided to aid in astronaut protection while in the water after egress. The sealed packet shall be attached to the large pressure bulkhead shield and shall be vented to prevent damage to the packet during rapid ascent of the spacecraft. Provisions shall be made for opening the packet at impact skirt extension.

3.17.3.3 FLASHING RECOVERY LIGHT - A high-intensity flashing recovery light (Drawing No. 45-86702) shall be provided. Flashing rate of the light shall be at least 15 flashes per minute at an intensity which shall be visible below 12,000 feet at a distance of approximately 50 nautical miles on a starlit moonless night at a relative humidity of at least 90 percent. The light shall be powered by its own battery.

3.17.3.4 SOFAR BOMB. - A SOFAR bomb shall be provided. The bomb shall be ejected at main parachute deployment and shall be preset to detonate at a depth of 2500 feet.

CONFIDENTIAL

DATE 26 November 1962

ST. LOUIS, MISSOURI

PAGE 89

REVISED _____

REPORT 6603-15A

REVISED _____

MODEL Mercury Spacecraft~~CONFIDENTIAL~~

3.17.3.5 IMPACT SENSOR - The impact sensor (dual inertia switch) shall perform the following functions:

- a. Initiate main parachute disconnect, reserve parachute ejector and disconnect, and the pilot parachute deployment gun (with RESCUE toggle switch (P-15) in MAN position).
- b. Energize a ten-minute time delay which shall, upon runout, initiate main parachute disconnect, reserve parachute ejector and disconnect, and the pilot parachute deployment gun, and energize a 30-second time delay relay for initiation of whip antenna extension and rescue beacon operation, in the event that the RESCUE toggle switch (P-15) is in AUTO position.
- c. Energize HF rescue antenna for HF SEASAVE direction finding beacon.
- d. Start recovery flashing light.
- e. De-energize excess communications and instrumentation.
- f. Energize a ten-minute time delay relay which upon runout shall de-energize the S-Band and C-Band beacons, telemetry unit and tape recorder.
- g. Energize a 30-second time delay relay (when the RESCUE switch (P-15) circuit is closed). This time delay relay shall initiate the HF whip antenna extension and energize the SEASAVE beacon and HF transmitter.

3.17.4 SURVIVAL KIT - Survival equipment as supplied by the Government shall be packaged in a contractor-furnished container conforming to the requirements of Drawing No. 45-81029. The container shall be partitioned into two compartments; one (snap enclosed) for housing a NASA-furnished one-man raft and water bladder (see Paragraph 3.8.4); and one (zipper enclosed) for housing the balance of the survival gear. A lanyard 96.0 inches long, with a snap fastener, shall be provided to join the astronaut, survival kit and/or spacecraft together. A retention line shall be provided in the container for connecting the life raft and survival kit. Stowage provisions shall be made for the astronaut's suit neck dam, and for the knife and flashlight at time of egress. Survival equipment provided by the Government shall be as described in Appendix I-A, Item 1, and Appendix I-B, Item 1. The survival kit shall be packed by the contractor and shipped to the launch site for installation in the spacecraft. The survival kit shall be installed in a support assembly to the left of the astronaut. The

~~CONFIDENTIAL~~

DATE 26 November 1962

ST. LOUIS, MISSOURI

PAGE 90

REVISED _____

REPORT 6603-15A

REVISED _____

MODEL Mercury Spacecraft3.17.4 SURVIVAL KIT - (Continued)

support assembly shall incorporate a neoprene-coated nylon cover consisting of two overlapping flaps. These flaps are retained in the closed position by two quick-release pins which are connected by a nylon strap. A single pull on a handle attached to the central portion of this strap shall release the retaining pins, permitting removal of the survival kit.

DATE 26 November 1962

MCDONNELL

ST. LOUIS, MISSOURI

PAGE 91

REVISED _____

REPORT 6603-15A

REVISED _____

MODEL Mercury Spacecraft

3.18 HANDLING PROVISIONS - A hoist loop assembly (Drawing No. 45-32263) shall be provided for spacecraft pickup by helicopter. The loop shall be attached to the recovery compartment structural assembly by two hoist loop support fittings. The hoist loop shall be constructed of 9,000 pound capacity dacron webbing with a fiber-glas plastic spring strap taped to the dacron to cause the loop to erect upon ejection of the antenna assembly. Two auxiliary hoist fittings (Drawing No. 45-32068) located diametrically opposite each other on spacecraft station line Z123.00, shall be provided.

3.19 SUPPORT EQUIPMENT - Support equipment for Mercury spacecraft shall be as separately negotiated in CCP 52 Series.

3.20 PYROTECHNICS - Pyrotechnic devices in accordance with Drawing No. 45-72001 (as specified in Appendix I-C, Item 11 herein) shall be provided for the following:

- a. Umbilical disconnect
- b. Capsule-adapter clamp ring separation
- c. Tower clamp ring separation
- d. Retrograde package release
- e. Parachute deployment and disconnect
- f. Antenna assembly ejection
- g. Rescue antenna extension
- h. Heat shield release
- i. Descent antenna release
- j. Explosive hatch release
- k. Snorkel inlet door jettison
- l. Horizon scanner cover release
- m. Dipole antenna extension and coax cutter actuation
- n. Auxiliary fuel pressurization valve actuation
- o. SOFAR bomb

Pyrotechnics, with the exception of h and n above, shall be installed at the launch site.

DATE 26 November 1962

ST. LOUIS, MISSOURI

PAGE 92

REVISED _____

REPORT 6603-15A

REVISED _____

MODEL Mercury Spacecraft

4.0 QUALIFICATION

4.1 M.A.C. QUALIFICATION - Qualification of equipment and sub-systems shall be accomplished by M.A.C. or by subcontractors under M.A.C. direction as defined in M.A.C. Report 6495 and in component specification control drawings. Qualification status of parts shall be as tabulated in M.A.C. Report 8140, dated 27 March 1961, revised 1 May 1962.

4.2 NASA QUALIFICATION - The spacecraft supplied by the contractor will be used in a qualification flight test program to be conducted by the NASA. The spacecraft and its systems shall demonstrate satisfactory performance within the framework of this specification. This qualification program will have as its final objective the accomplishment of the mission described in Paragraph 1.1.1 herein, launching of a manned spacecraft into a semipermanent orbit and subsequent safe return to the surface of the earth at a designated time and/or position through use of retrograde thrust and aerodynamic drag.

5.0 TESTING

5.1 M.A.C. TESTING - The contractor shall undertake structural, aerodynamic, hydrodynamic, equipment, compatibility, acceptance, and evaluation tests as required in support of the spacecraft development program.

5.2 NASA TESTING - A program of research and development flight testing of Spacecraft No. 15A will be undertaken by the NASA. The spacecraft described herein shall be utilized in Mercury-Atlas Test Shot No. 10.

6.0 DEFINITIONS

NASA	-	National Aeronautics and Space Administration
M.A.C.	-	McDonnell Aircraft Corporation
Normal land impact	-	Landing in the vicinity of the launching pad at Cape Canaveral. This local terrain shall be studied so that the soil characteristics used in landing calculations will represent conservative values for a large percentage of the possibilities. Wind drift and parachute swing angles used will be based on probability studies.

DATE 26 November 1962

ST. LOUIS, MISSOURI

PAGE 93

REVISED _____

REPORT 6603-15A

REVISED _____

CONFIDENTIAL

MODEL Mercury Spacecraft

APPENDIX I-A

GOVERNMENT-FURNISHED EQUIPMENT - CONTRACTOR INSTALLED

<u>Item</u>	<u>Qty.</u>	<u>Nomenclature</u>
*1	-	Survival Equipment as Follows: (See Paragraph 3.17.4)
1.1	1	One-Man Life Raft
1.2	1	Chemical Desalting Kit (for 8 pints)
1.3	1	Shark Chaser Packet
1.4	3	Dye Marker Packets
1.5	1	Battery-Powered Survival Light (ACR-4-E or equivalent)
1.6	1	Signal Mirror
1.7	1	First Aid Kit Consisting of:
1.7.1	As Req.	Gauze Compress
1.7.2	As Req.	Gauze Bandage
1.7.3	15	Oxytetracycline Tablets (4 grains each)
1.7.4	6	Motion-Sickness Tablets (Meclizine - 3/8 grain each)
1.7.5	As Req.	Muslin Bandage
1.7.6	1	Small Cake of Soap
1.7.7	1	Tube of Zinc Oxide Ointment (Approx. 2-1/2 oz.)
1.8	1	Signal Whistle
1.9	1	Small Can Survival Rations
1.10	18	Full-Size Waterproof Matches in Waterproof Metal Container (Additional match heads shall be contained in the survival knife handle)
1.11	10 ft.	Multibraided Nylon Line (Fish hooks shall be contained in survival knife handle)
1.12	1	Small Pocket Knife
1.13	1	SARAH Radio Beacon with Antenna and Battery (Ultra RB-5 and RB-7)
1.14	1	Sunglasses
2		Food, Low Residue
3	4	Film Pack, Cosmic Ray (See Paragraph 3.15.3)

* The Survival Kit shall be packed by the contractor and shipped to the launch site for installation in the spacecraft.

DATE 26 November 1962
REVISED _____
REVISED _____

MCDONNELL

ST. LOUIS, MISSOURI

PAGE 94
REPORT 6603-15A
MODEL Mercury Spacecraft

CONFIDENTIAL

APPENDIX I-A - (Continued)

GOVERNMENT-FURNISHED EQUIPMENT - CONTRACTOR INSTALLED

<u>Item</u>	<u>Qty.</u>	<u>Nomenclature</u>	
4	-	Connectors, Pressure Suit, Consisting of:	
4.1	1	Suit Inlet Hose	
4.2	1	Suit Outlet Hose	
4.3	2	Instrumentation Patch, 16-Terminal (1 Inside, 1 Outside)	
5	1	Face Piece Seal Bottle, B. F. Goodrich P/N 3P1056, Including:	
5.1	-	1 - Bottle	
5.2	-	1 - Reducer	
5.3	-	1 - Hose	
6	1	Flashlight, with Batteries, Size C Cell (See Paragraph 3.8.5.2)	
7	1	CO ₂ Partial Pressure Sensor	807-140114
8	1	Card, Amplifier, CO ₂ Partial Pressure	807-140115
9	1	Commutator-Keyer Record Amplifier, Low-Level	C40705
10	1	Calibrator	45-87700-57 (BG161A-10)

MCDONNELL

ST. LOUIS, MISSOURI

DATE 26 November 1962

REVISED _____

REVISED _____

PAGE 95

REPORT 6603-15A

MODEL Mercury Spacecraft

~~CONFIDENTIAL~~

APPENDIX I-B

GOVERNMENT-FURNISHED EQUIPMENT - GOVERNMENT INSTALLED

<u>Item</u>	<u>Qty.</u>	<u>Nomenclature</u>
1	3	Injectors (See Paragraph 3.17.4)

~~CONFIDENTIAL~~

MCDONNELL

ST. LOUIS, MISSOURI

DATE 26 November 1962

REVISED _____

REVISED _____

PAGE 96REPORT 6603-15AMODEL Mercury Spacecraft~~CONFIDENTIAL~~APPENDIX I-CCONTRACTOR-FURNISHED EQUIPMENT - CONTRACTOR INSTALLEDGENERALIDENTIFICATION

<u>Item</u>	<u>Qty.</u>	<u>Nomenclature</u>	<u>M.A.C. No.</u>	<u>Mfg. No.</u>
1		General Assembly, Mercury Including:	45-00001-53	-
1.1	1	Pylon Assembly, Escape	45-31001-315 *	-
1.2	1	Antenna Assembly, Communications	45-31003-305	-
1.3	1	Capsule Assembly	45-32000-313	-
1.3.1	1	Structural Assembly, Capsule	45-32001-303	-
1.3.1.1	1	Structural Assembly Conical Section	45-32002-303 *	-
1.3.1.1.1	1	Window Assembly, Capsule Inner (Forward Viewing)	45-35035-303	-
1.3.1.1.2	1	Shield, Bulkhead Fiber- glas	45-32290-315	-
1.3.1.2	1	Structural Assembly, Cylindrical Section	45-32003-301	-
1.3.2	1	Shingle Installation, Capsule	45-32245-301 *	-
1.3.3	1	Insulation Installation	45-32038-315 *	-
1.3.4	1	Door Assembly	45-32091-305	-
1.3.5	1	Window Assembly, Capsule Outer	45-35030-1 *	-

* To be shipped to launch site for installation

~~CONFIDENTIAL~~

DATE 26 November 1962**MCDONNELL**

ST. LOUIS, MISSOURI

PAGE 97

REVISED _____

REPORT 6603-15A

REVISED _____

CONFIDENTIALMODEL Mercury SpacecraftAPPENDIX I-CCONTRACTOR-FURNISHED EQUIPMENT - CONTRACTOR INSTALLEDGENERAL - (Continued)IDENTIFICATION

<u>Item</u>	<u>Qty.</u>	<u>Nomenclature</u>	<u>M.A.C. No.</u>	<u>Mfg. No.</u>
1.3.6	1	Impact Cushion Installation, Including:	45-32300-317 *	-
1.3.6.1	1	Heat Shield Assembly	45-32052-327	-
1.3.6.2	2	Valve, Jettison	45-61700-482	Bell: 8060-472-091-3
1.3.6.3	1	Impact Skirt	45-32700-3	-
1.3.7	1	Hatch Installation	45-35003-1	-
1.4	1	Structural Assembly, Atlas Adapter	45-33002-309 *	-
1.5	1	System Installation, Recovery (See Item 10)	45-41001-320 *	-
1.6	1	Rocket Installation Retrograde (See Item 2)	45-50001-321 *	-
1.6.1	3	Strap Assembly	45-72030-303 *	-
1.6.2	1	Structural Assembly	45-50002-303	-
1.7	1	Rocket Installation, Safety (See Item 2)	45-51001-307 *	-
1.7.1	1	Escape Rocket Structural Assembly	45-51002-309 *	-
1.7.1.1	1	Ballast Assembly	45-51010-303 *	-
1.7.1.2	1	Spike Assembly, Ballasted Aerodynamic	45-51017-1	-

* To be shipped to launch site for installation

MCDONNELLDATE 26 November 1962

ST. LOUIS, MISSOURI

PAGE

98

REVISED

REPORT

6603-15A

REVISED

MODEL

Mercury Spacecraft

APPENDIX I-CCONTRACTOR-FURNISHED EQUIPMENT - CONTRACTOR INSTALLEDGENERAL - (Continued)IDENTIFICATION

<u>Item</u>	<u>Qty.</u>	<u>Nomenclature</u>	<u>M.A.C. No.</u>	<u>Mfg. No.</u>
1.8	1	System Installation, Manual Controls	45-61001-313	-
1.8.1	1	Installation, Abort Handle	45-61002-301	-
1.8.2	1	Installation, Hand Controller	45-61010-301	-
1.8.3	1	Installation, Controls, Yaw	45-61020-311	-
1.8.4	1	Installation, Controls, Pitch	45-61030-313	-
1.8.5	1	Installation, Controls, Roll	45-61040-317	-
1.8.6	1	Installation, System, H ₂ O ₂ Shutoff	45-61075-315	-
1.9	1	Installation, System, Reaction Controls (See Item 6)	45-62001-51	-
1.9.1	1	Installation, Pressuri- zation, Reaction Controls, Manual and Automatic	45-62010-337	-
1.9.2	1	Installation, Fuel, Reaction Control	45-62100-23	-
1.9.3	1	Installation, Fuel Reaction Control	45-62100-25	-
1.9.4	1	Installation, Min. "K" Insulation, Reaction Controls	45-62049-333	-

DATE 26 November 1962
REVISED _____
REVISED _____

MCDONNELL

ST. LOUIS, MISSOURI

PAGE 99
REPORT 6603-15A
MODEL Mercury Spacecraft

APPENDIX I-C

CONTRACTOR-FURNISHED EQUIPMENT - CONTRACTOR INSTALLED

GENERAL - (Continued)

<u>IDENTIFICATION</u>				
<u>Item</u>	<u>Qty.</u>	<u>Nomenclature</u>	<u>M.A.C. No.</u>	<u>Mfg. No.</u>
1.9.5	1	Installation, Min. "K" Insulation, Reaction Controls	45-62049-335	-
1.9.6	1	Lines Installation, Vent	45-62075-303	-
1.10	1	System Installation, Pyro- technics (See Item 11)	45-72001-20 *	-
1.10.1	1	Installation Conical Fair- ing Pylon to Capsule	45-72045-1 *	-
1.10.1.1	1	Fairing Assembly, Pylon to Capsule, Conical	45-72043-1 *	-
1.10.2	1	Clamp Ring, Capsule - Adapter	45-72100-305 *	-
1.10.3	1	Installation, Antenna Fairing Ejector	45-72020-303	-
1.10.4	1	Installation, Retaining Ring, Pylon to Capsule	45-72042-1 *	-
1.10.5	1	Installation, Emergency Controls (Manual)	45-72050-309	-
1.11	1	Electrical Installation, Escape Rocket	45-77000-1 *	-
1.12	1	Electrical Installation, Pylon	45-77001-301	-
1.13	1	Electrical Installation, Antenna Fairing	45-77002-315	-
1.14	1	Electrical Installation, Midsection	45-78003-321	-

MCDONNELL

ST. LOUIS, MISSOURI

DATE 26 November 1962PAGE 100

REVISED _____

REPORT 6603-15A

REVISED _____

MODEL Mercury Spacecraft~~CONFIDENTIAL~~APPENDIX I-CCONTRACTOR-FURNISHED EQUIPMENT - CONTRACTOR INSTALLEDGENERAL - (Continued)IDENTIFICATION

<u>Item</u>	<u>Qty.</u>	<u>Nomenclature</u>	<u>M.A.C. No.</u>	<u>Mfg. No.</u>
1.15	1	Electrical Installation, Ablation Shield	45-78001-315	-
1.16	1	Electrical Installation Retrorocket	45-78002-329 *	-
1.17	1	Electrical Installation, Adapter - Atlas	45-79001-307 *	-
1.18	1	Equipment Installation (See Items 3, 4, 5, 6, 7, 8 and 9), Including:	45-80020-1	-
1.18.1	1	Equipment Installation, Console, Right-Hand	45-81002-341 *	-
1.18.2	1	Installation, Lines, Static	45-81004-303	-
1.18.3	1	Panel Assembly, Fuse Switch	45-81014-329	-
1.18.4	1	Binder Assembly, Naviga- tional Aid Kit	45-81087-305 *	-
1.18.5	1	Navigational Aid Kit	45-81089-301	-
1.18.6	1	Installation, Window Pole and Flashlight	45-81098-301	-
1.18.7	1	Main Instrument Panel	45-81100-323 *	-
1.18.8	1	Panel Assembly, Left- Hand Console	45-81110-331	-

* To be shipped to launch site for installation

MCDONNELLDATE 26 November 1962

ST. LOUIS, MISSOURI

PAGE 101

REVISED _____

REPORT 6603-15A

REVISED _____

CONFIDENTIALMODEL Mercury SpacecraftAPPENDIX I-CCONTRACTOR-FURNISHED EQUIPMENT - CONTRACTOR INSTALLEDGENERAL - (Continued)

<u>Item</u>	<u>Qty.</u>	<u>Nomenclature</u>	<u>M.A.C. No.</u>	<u>Mfg. No.</u>
1.18.9		Container Assembly, Drinking Water	45-81461-301*	
1.18.10	2	Crushable Support Assem- bly, Pilot Seat	45-82001-301-xx*	-
1.18.11	1	Installation, Harness Reel and Release Linkage	45-82013-313	-
1.18.12	2	Crushable Support Assem- bly, Pilot Seat	45-82057-301-xx*	-
1.18.13	1	Installation, Face Lens Seal Bottle	45-82070-1 *	-
1.18.14	1	Harness Assembly, Crewman Restraint	45-82702-305 *	-
1.18.15	1	Installation, Control	45-83001-307	-
1.18.16	1	Installation, Regulator, Cabin Pressure	45-83002-321	-
1.18.17	1	Installation, Valve, Inlet and Outlet	45-83005-325	-
1.18.18	1	Installation, Coolant Lines	45-83006-315*	-
1.18.19	1	Installation, ECS Lines	45-83060-321*	-
1.18.20	1	Installation, Inverter Cooling Duct	45-83144-7 *	-
1.18.21	1	Installation, Inverter Cooling Duct	45-83144-11 *	-

* To be shipped to launch site for installation.

DATE 26 November 1962**MCDONNELL**

ST. LOUIS, MISSOURI

PAGE 102

REVISED _____

REPORT 6603-15A

REVISED _____

~~CONFIDENTIAL~~MODEL Mercury SpacecraftAPPENDIX I-CCONTRACTOR-FURNISHED EQUIPMENT - CONTRACTOR INSTALLEDGENERAL - (Continued)IDENTIFICATION

<u>Item</u>	<u>Qty.</u>	<u>Nomenclature</u>	<u>M.A.C. No.</u>	<u>Mfg. No.</u>
1.18.22	1	Installation, Blood Pressure Measuring System	45-83192-301 *	-
1.18.23	1	Filter Assembly, Window	45-86005-307 *	-
1.18.24	1	Tank Assembly, Auxiliary Cooling Water	45-83207-1 *	-

* To be shipped to launch site for installation

DATE 26 November 1962**MCDONNELL**

ST. LOUIS, MISSOURI

PAGE 103

REVISED _____

REPORT 6603-15A

REVISED _____

~~CONFIDENTIAL~~MODEL Mercury SpacecraftAPPENDIX I-CCONTRACTOR-FURNISHED EQUIPMENT - CONTRACTOR INSTALLEDGENERAL - (Continued)

Item	Astronaut	Seat Inst. Astronaut 45-82003*	R.H. Arm Rest 45-82003*	L.H. Arm Rest 45-82003*	Seat Ass'y Astronaut Contoured 45-82000*	Head Ass'y 45-82000*	Back Ass'y 45-82000*
1.18.26	Carpenter	-1	-33	-17	-1	-17	-33
1.18.27	Cooper	-3	-35	-19	-3	-19	-35
1.18.28	Glenn	-5	-37	-21	-5	-21	-37
1.18.29	Grissom	-7	-39	-23	-7	-23	-39
1.18.30	Schirra	-9	-41	-25	-9	-25	-41
1.18.31	Shepard	-11	-43	-27	-11	-27	-43
1.18.32	Slayton	-13	-45	-29	-13	-29	-45

* These items to be shipped to launch site for installation.

~~CONFIDENTIAL~~

MCDONNELL

ST. LOUIS, MISSOURI

DATE 26 November 1962PAGE 104

REVISED _____

REPORT 6603-15A

REVISED _____

MODEL Mercury Spacecraft~~CONFIDENTIAL~~APPENDIX I-CCONTRACTOR-FURNISHED EQUIPMENT - CONTRACTOR INSTALLEDROCKET SYSTEMS

			<u>IDENTIFICATION</u>	
<u>Item</u>	<u>Qty.</u>	<u>Nomenclature</u>	<u>M.A.C. No.</u>	<u>Mfg. No.</u>
2		Spacecraft Rocket Installations	*	-
2.1	3**	Rocket Assembly, Retrograde Consisting of:	45-50700-33*	Thiokol: TE-316-31
2.1.1	1	Rocket, Retrograde	45-50700-3 *	Thiokol: TE-316-3
2.1.1.1	2	Igniter, Pyrogen	- *	Thiokol: TE-343
2.2	3	Rocket, Posigrade	45-50701-3 *	Atlantic Research: D20763
2.3	1	Rocket, Escape System	45-51700-3 *	Grand Central: 477-80100-3
2.4	1	Rocket, Pylon Jettison	45-51701-15*	Atlantic Research: E22851

* To be shipped to launch site for installation

** One of these rocket assemblies is modified in accordance with Drawing No. 45-50030 by addition of 45-88891 Temperature Transducer.

~~CONFIDENTIAL~~

DATE 26 November 1962**MCDONNELL**

ST. LOUIS, MISSOURI

PAGE 105

REVISED _____

REPORT 6603-15A

REVISED _____

~~CONFIDENTIAL~~MODEL Mercury SpacecraftAPPENDIX I-CCONTRACTOR-FURNISHED EQUIPMENT - CONTRACTOR INSTALLEDAIRBORNE EQUIPMENTIDENTIFICATION

<u>Item</u>	<u>Qty.</u>	<u>Nomenclature</u>	<u>M.A.C. No.</u>	<u>Mfg. No.</u>
3		Airborne Equipment, Consisting of:	-	-
3.1	1	Longitudinal Accelerometer (See Paragraph 3.8.9.3)	45-81702-11 *	Burton: 2062C
3.2	1	Altimeter (Modified by 45-81344)	45-81704-5	Kollsman Instruments A 33841-10-001
3.3	1	Satellite Clock (See Paragraph 3.8.9.1)	45-81710-13	M.A.C. 45-81120-303
3.4	1	D.C. Voltmeter	45-81716-3	Weston Instrument: 183537
3.5	1	D.C. Ammeter	45-81717-3	Weston Instrument: 183538
3.6	1	A.C. Voltmeter	45-81718-3	Weston Instrument: 183539
3.7	1	Indicator, Automatic/ Manual Fuel	45-81719-9	Weston Instrument: 185377
3.8	1	Indicator, H ₂ O ₂ Pressure	45-81719-11	Weston Instrument:
3.9	1	Transducer (Pitch)	45-81721-5	Minneapolis- Honeywell: GG 134A-8
3.10	1	Transducer (Yaw)	45-81721-9	Minneapolis- Honeywell: GG 134A-9
3.11	1	Transducer (Roll)	45-81721-19 *	Minneapolis- Honeywell: GG 134A-7

* To be shipped to launch site for installation

DATE 26 November 1962
REVISED _____
REVISED _____

MCDONNELL

ST. LOUIS, MISSOURI

PAGE 106
REPORT 6603-15A
MODEL Mercury Spacecraft

~~CONFIDENTIAL~~

APPENDIX I-C

CONTRACTOR-FURNISHED EQUIPMENT - CONTRACTOR INSTALLED

AIRBORNE EQUIPMENT - (Continued)

IDENTIFICATION

<u>Item</u>	<u>Qty.</u>	<u>Nomenclature</u>	<u>M.A.C. No.</u>	<u>Mfg. No.</u>
3.12	1	Indicator, Angular Rate and Attitude (See Paragraph 3.8.9.2)	45-81721-27 *	Minneapolis-Honeywell: JG 282A-6
3.13	1	Indicator, Rate of Descent	45-81723-3	Pioneer-Central: 1652-15A-B15-1
3.14	1	Indicator, Temperature and Pressure	45-81724-5	Weston Instrument: 190914
3.15	1	Indicator, (Dual) Temperature	45-81724-7	Weston Instrument: 196332
3.16	1	Indicator, Partial Pressure, O ₂ and CO ₂	45-81725-5	Weston Instrument: 185917
3.17	1	Indicator, Sensor	45-83701-9	Weston Instrument
3.18	1	Indicator, (Dual) O ₂ Quantity	45-83706-11 *	Weston Instrument:
3.19	1	Indicator, Cabin Pressure	45-83707-3	Kollsman Instrument: A 33681-10-001
3.20	1	Indicator, Cabin Air	45-83708-5 *	Weston Instrument: 183513A
3.21	2	Horizon Scanner (See Paragraph 3.10.2)	45-87702-9	Barnes Engineering: 13-130A-1

* To be shipped to launch site for installation

MCDONNELLDATE 26 November 1962

ST. LOUIS, MISSOURI

PAGE 107

REVISED _____

REPORT 6603-15A

REVISED _____

~~CONFIDENTIAL~~MODEL Mercury SpacecraftAPPENDIX I-CCONTRACTOR-FURNISHED EQUIPMENT - CONTRACTOR INSTALLEDELECTRICAL SYSTEMIDENTIFICATION

<u>Item</u>	<u>Qty.</u>	<u>Nomenclature</u>	<u>M.A.C. No.</u>	<u>Mfg. No.</u>
4		Electrical Equipment, Consisting of:	-	-
4.1	1	Diode Panel Assembly, Power System Control	45-78012-321	-
4.2	1	Relay Panel Assembly, Tone Generator Control	45-78018-303	-
4.3	1	Panel Assembly, Power System Filter	45-78021-303	-
4.4	10	Solid Conductor	45-78033-3 *	-
4.5	1	Diode Panel Assembly, Abort Control Circuit	45-78034-301	-
4.6	1	Diode Panel Assembly, Abort Control Circuit	45-78034-305	-
4.7	1	Relay Panel Assembly, Clamp Ring Separation	45-78041-307 *	-
4.8	1	Panel Assembly, Capacitor Time Delay Relay	45-78054-301	-
4.9	1	Panel Assembly, Capacitor Time Delay Relay	45-78054-303	-
4.10	1	Panel Assembly, Capacitor Time Delay Relay	45-78054-305	-
4.11	1	Panel Assembly, Relay	45-78065-1 *	-
4.12	1	Filter Assembly, Scanner	45-78068-1	-

* To be shipped to launch site for installation

DATE 26 November 1962

ST. LOUIS, MISSOURI

PAGE 108

REVISED _____

REPORT 6603-15A

REVISED _____

~~CONFIDENTIAL~~MODEL Mercury SpacecraftAPPENDIX I-CCONTRACTOR-FURNISHED EQUIPMENT - CONTRACTOR INSTALLEDELECTRICAL SYSTEM - (Continued)IDENTIFICATION

<u>Item</u>	<u>Qty.</u>	<u>Nomenclature</u>	<u>M.A.C. No.</u>	<u>Mfg. No.</u>
4.13	1	Filter Assembly, Scanner	45-78068-301	-
4.14	1	Panel Assembly Microphone Resistor	45-78069-1	-
4.15	21	Fuse Holder Assembly	45-78070-1	-
4.16	21	Fuse Holder Assembly	45-78070-3	-
4.17	9	Fuse Holder Assembly	45-78070-11	-
4.18	2	Heater-Horizon Scanner	45-78071-1	-
4.19	1	Panel Assembly, Relay	45-78072-301	-
4.20	1	Panel Assembly, Relay Instru- mentation and Communications	45-78074-303	-
4.21	1	Panel Assembly, Relay, VOX Recorder	45-78078-301	-
4.22	1	Relay Panel Assembly, Power System Control	45-78081-337 *	-
4.23	1	Relay Panel Assembly, Power System Control	45-78081-345	-
4.24	1	Relay Panel Assembly, Launch, Orbit and Escape Sequential	45-78084-327	-
4.25	1	Relay Panel Assembly, Launch Orbit and Escape Sequential	45-78084-355	-
4.26	1	Relay Panel Assembly, Launch, Orbit and Escape Sequential	45-78084-369	-
4.27	1	Relay Panel Assembly, Retrograde Sequential	45-78085-377 *	-

* To be shipped to launch site for installation

~~CONFIDENTIAL~~

MCDONNELLDATE 26 November 1962

ST. LOUIS, MISSOURI

PAGE 109

REVISED _____

REPORT 6603-15A

REVISED _____

~~CONFIDENTIAL~~MODEL Mercury SpacecraftAPPENDIX I-CCONTRACTOR-FURNISHED EQUIPMENT - CONTRACTOR INSTALLEDELECTRICAL SYSTEM - (Continued)IDENTIFICATION

<u>Item</u>	<u>Qty.</u>	<u>Nomenclature</u>	<u>M.A.C. No.</u>	<u>Mfg. No.</u>
4.28	1	Relay Panel Assembly, Recovery Sequential	45-78086-381	-
4.29	1	Relay Panel Assembly,	45-78086-399 *	-
4.30	1	Relay Panel Assembly,	45-78090-363 *	-
4.31	1	Relay Panel Assembly,	45-78090-359	-
4.32	1	Relay Panel Assembly, Instrumentation Control	45-78092-313	-
4.33	1	Panel Assembly, VCO, Stick Position	45-78099-1 *	-
4.34	1	Jumper Plug Assembly	45-79025-301	-
4.35	1	Battery (1500 Watt-Hour)	45-79707-19 *	Eagle Picher: MAR-4028-B
4.36	5	Battery (3000 Watt-Hour)	45-79707-21 *	Eagle Picher: MAR-4027-B
4.37	2	Filter Assembly	45-79709-7	Interelectronics 28FA30GHA-2
4.38	2	Static Inverter (250 VA) (Modified by 45-87046 & 45-87047)	45-79709-9 *	Interelectronics 28T15A40HA-3
4.39	1	Static Inverter (150 VA) (Modified by 45-87052)	45-79709-11	Interelectronics 28T15A40GB-3
4.40	85	Power and Control Relay	45-79712-2	Filtors: P26A1H6A9

* To be shipped to launch site for installation

DATE 26 November 1962

ST. LOUIS, MISSOURI

PAGE 110

REVISED _____

REPORT 6603-15A

REVISED _____

CONFIDENTIALMODEL Mercury SpacecraftAPPENDIX I-CCONTRACTOR-FURNISHED EQUIPMENT - CONTRACTOR INSTALLEDELECTRICAL SYSTEM - (Continued)IDENTIFICATION

<u>Item</u>	<u>Qty.</u>	<u>Nomenclature</u>	<u>M.A.C. No.</u>	<u>Mfg. No.</u>
4.41	6	Power and Control Relay	45-79712-12	Leach: 9227-5369
4.42	1	Power and Control Relay	45-79712-15	Leach: 9226-5368
4.43	7	Power and Control Relay	45-79712-16	Leach: 9224-5367
4.44	17	Power and Control Relay	45-79712-19	Leach: 9229-5271
4.45	13	Power and Control Relay	45-79712-21	Leach: 9220-5366
4.46	5	Power and Control Relay	45-79712-22	Leach: 9228-5370
4.47	5	Power and Control Relay	45-79712-23	Leach: 9223-5375
4.48	1	Power and Control Relay	45-79712-26	Leach: 9274-5300
4.49	1	Power and Control Relay	45-79712-28	Leach: 9229-5372
4.50	2	Power and Control Relay	45-79712-32	Leach: 9220-5378
4.51	7	Power and Control Relay	45-79712-33	Filtors: 268R18F
4.52	13	Power and Control Relay	45-79712-34	Filtors: LI26E18J
4.53	41	Power and Control Relay	45-79712-35	Potter-Brumfield SL4170

DATE 26 November 1962**MCDONNELL**

ST. LOUIS, MISSOURI

PAGE

111

REVISED _____

REPORT

6603-15A

REVISED _____

MODEL

Mercury Spacecraft~~CONFIDENTIAL~~APPENDIX I-CCONTRACTOR-FURNISHED EQUIPMENT - CONTRACTOR INSTALLEDELECTRICAL SYSTEM - (Continued)IDENTIFICATION

<u>Item</u>	<u>Qty.</u>	<u>Nomenclature</u>	<u>M.A.C. No.</u>	<u>Mfg. No.</u>
4.54	1	Push Button	45-79713-23	Haydon Switch: 61375
4.55	12	Limit Switch	45-79713-29	Electro-Snap: KX5-4-1
4.56	1	Limit Switch	45-79713-39	Haydon: 61422
4.57	3	Limit Switch	45-79713-59	Electro-Snap: H11-120
4.58	2	Limit Switch	45-79713-61	Electro-Snap: H11-121
4.59	4	Limit Switch	45-79713-65	Electro-Snap: H11-123
4.60	1	Limit Switch	45-79713-69	Electro-Snap: H11-125
4.61	4	Limit Switch	45-79713-71	Electro-Snap: H11-127
4.62	4	Limit Switch	45-79713-73	Electro-Snap: H11-128
4.63	8	Push Button	45-79713-79	Haydon: 61615
4.64	7	Relay - Time Delay 2 Seconds	45-79715-1	Wheaton: E371-A
4.65	3	Relay - Time Delay 5 Seconds	45-79715-7	Wheaton: E371-D
4.66	1	Relay - Time Delay 10 Seconds	45-79715-11	Wheaton: E371-E

MCDONNELLDATE 26 November 1962

ST. LOUIS, MISSOURI

PAGE 112

REVISED _____

REPORT 6603-15A

REVISED _____

MODEL Mercury SpacecraftAPPENDIX I-CCONTRACTOR-FURNISHED EQUIPMENT - CONTRACTOR INSTALLEDELECTRICAL SYSTEM - (Continued)IDENTIFICATION

<u>Item</u>	<u>Qty.</u>	<u>Nomenclature</u>	<u>M.A.C. No.</u>	<u>Mfg. No.</u>
4.67	1	Relay - Time Delay 30 Seconds	45-79715-17	Wheaton: E371-H
4.68	1	Relay - Time Delay 30 Seconds	45-79715-33	Wheaton: E372A
4.69	1	Relay - Time Delay 60 Seconds	45-79715-39	Wheaton: E372-F
4.70	2	Relay - Time Delay 600 Seconds	45-79715-45	Wheaton: E409-A
4.71	2	Relay - Time Delay 5 Seconds	45-79715-51	Wheaton: E372-G
4.72	2	Relay - Time Delay 10 Seconds	45-79715-53	Wheaton: E372-H
4.73	3	Relay - Time Delay 1 Second	45-79715-55	Wheaton: E372-J
4.74	5	Relay - Time Delay 12 Seconds	45-79715-57	Wheaton: E372-K
4.75	2	Relay - Time Delay 2 Seconds	45-79715-63	Wheaton: E372-R
4.76	1	Relay - Time Delay 300 Seconds	45-79715-67	Wheaton: E376-A
4.77	1	Relay - Time Delay 23 Seconds	45-79715-71	Wheaton: E372-N
4.78	1	Relay - Time Delay 60 Seconds	45-79715-75	Wheaton: E372-T
4.79	1	Thrust Cutoff Sensor	45-87709-5	Donner Scientific 4403-2-300-020

MCDONNELLDATE 26 November 1962

ST. LOUIS, MISSOURI

PAGE 113

REVISED _____

REPORT 6603-15A

REVISED _____

MODEL Mercury SpacecraftAPPENDIX I-CCONTRACTOR-FURNISHED EQUIPMENT - CONTRACTOR INSTALLEDELECTRICAL SYSTEM - (Continued)IDENTIFICATION

<u>Item</u>	<u>Qty.</u>	<u>Nomenclature</u>	<u>M.A.C. No.</u>	<u>Mfg. No.</u>
4.80	3	Light Assembly (Green)	45-79720-49	33340-49-327
4.81	2	Light Assembly (Amber)	45-79720-103	33340-103-327
4.82	1	Telelight Assembly (RECORDING)	45-79720-117	Grimes: 33340-117-327
4.83	1	Telelight Assembly (JETT TOWER)	45-79720-141	Grimes: 33340-141-327
4.84	1	Telelight Assembly (SEP CAPSULE)	45-79709-145	Grimes: 33340-145-327
4.85	1	Telelight Assembly (RETRO SEQ)	45-79720-149	Grimes: 33340-149-327
4.86	1	Telelight Assembly (RETRO ATT)	45-79720-153	Grimes: 33340-153-327
4.87	1	Telelight Assembly (FIRE RETRO)	45-79720-157	Grimes: 33340-157-327
4.88	1	Telelight Assembly (JETT RETRO)	45-79720-161	Grimes: 33340-161-327
4.89	1	Telelight Assembly (.05G)	45-79720-169	Grimes: 33340-169-327
4.90	1	Telelight Assembly (MAIN)	45-79720-173	Grimes: 33340-173-327
4.91	1	Telelight Assembly (RESCUE)	45-79720-177	Grimes: 33340-177-327
4.92	1	Telelight Assembly (STBY AC-AUTO)	45-79720-185	Grimes: 33340-185-327

DATE 26 November 1962**MCDONNELL**

ST. LOUIS, MISSOURI

PAGE 114

REVISED _____

REPORT 6603-15A

REVISED _____

MODEL Mercury SpacecraftAPPENDIX I-CCONTRACTOR-FURNISHED EQUIPMENT - CONTRACTOR INSTALLEDELECTRICAL SYSTEM - (Continued)IDENTIFICATION

<u>Item</u>	<u>Qty.</u>	<u>Nomenclature</u>	<u>M.A.C. No.</u>	<u>Mfg. No.</u>
4.93	1	Telelight Assembly (O ₂ QUAN)	45-79720-193	Grimes: 33340-193-327
4.94	1	Telelight Assembly (O ₂ EMER)	45-79720-197	Grimes: 33340-197-327
4.95	1	Telelight Assembly (CO ₂ PRESS)	45-79720-205	Grimes: 33340-205-327
4.96	1	Telelight Assembly (FUEL QUAN)	45-79720-217	Grimes: 33340-217-327
4.97	1	Telelight Assembly (RETRO WARN)	45-79720-221	Grimes: 33340-221-327
4.98	1	Telelight Assembly (RETRO RESET)	45-79720-225	Grimes: 33340-225-327
4.99	1	Light Assembly (ABORT)	45-79720-237	Grimes: 34160-327-313
4.100	1	Telelight Assembly (LANDING BAG)	45-79720-241	Grimes: 33340-241-327
4.101	1	Telelight Assembly (OUT OF ORB MODE)	45-79720-259	Grimes: 33340-259-327
4.102	1	Telelight Assembly (UMBILICAL DOOR)	45-79720-263	Grimes: 33340-263-327
4.103	1	Telelight Assembly (EXCESS H ₂ O)	45-79720-267	Grimes: 33340-213-327
4.104	2	Plug, Tower Elec. Disconnect	45-79722-1	Cannon: 39884-1
4.105	2	Receptacle, Tower Elec. Disconnect	45-79722-3	Cannon: 39885-1

MCDONNELLDATE 26 November 1962

ST. LOUIS, MISSOURI

PAGE 115

REVISED _____

REPORT 6603-15A

REVISED _____

MODEL Mercury SpacecraftAPPENDIX I-CCONTRACTOR-FURNISHED EQUIPMENT - CONTRACTOR INSTALLEDELECTRICAL SYSTEM - (Continued)IDENTIFICATION

<u>Item</u>	<u>Qty.</u>	<u>Nomenclature</u>	<u>M.A.C. No.</u>	<u>Mfg. No.</u>
4.106	2	Cover, Tower Elec. Disconnect	45-79722-5	Cannon: 39886-1
4.107	1	Receptacle, Umbilical Disconnect Assembly	45-79723-1	Cannon: 17070-799
4.108	113	Fuse (5 Amp)	45-79727-3	Harris: 34020-5
4.109	3	Fuse (10 Amp)	45-79727-11	Harris: 34020-10
4.110	4	Fuse (25 Amp)	45-79727-13	Harris: 34020-25
4.111	31	Switch	45-79729-87	Harris: 34000-9
4.112	2	Switch - 8-Position Rotary	45-79731-1	Harris: 32000-1
4.113	2	Switch - 8-Position Rotary	45-79731-11 *	Harris: 32000-11
4.114	13**	Toggle Switch	45-79732-1	Cutler-Hammer: 8906K983
4.115	24	Toggle Switch	45-79732-13	Cutler-Hammer: 8906K984
4.116	2	Toggle Switch	45-79732-15	Cutler-Hammer: 8906K985
4.117	9	Toggle Switch	45-79732-25	Cutler-Hammer: 8906K986
4.118	4	Toggle Switch	45-79732-43	Cutler-Hammer: 8906K1024

** 4 of these switches are modified per Drawing No. 45-81299

* To be shipped to launch site for installation

DATE 25 November 1962**MCDONNELL**

ST. LOUIS, MISSOURI

PAGE 116

REVISED _____

REPORT 6603-15A

REVISED _____

~~CONFIDENTIAL~~MODEL Mercury SpacecraftAPPENDIX I-CCONTRACTOR-FURNISHED EQUIPMENT - CONTRACTOR INSTALLEDELECTRICAL SYSTEM - (Continued)IDENTIFICATION

<u>Item</u>	<u>Qty.</u>	<u>Nomenclature</u>	<u>M.A.C. No.</u>	<u>Mfg. No.</u>
4.119	3	Toggle Switch	45-79732-45	Cutler-Hammer: 8906KL023
4.120	2	Plug Assembly-Antenna	45-79736-1	Cannon: 22037-98
4.121	2	Receptacle Assembly - Antenna	45-79736-3	Cannon: 22037-93
4.122	4	Plug Assembly - Retrograde and Adapter	45-79736-9	Cannon: 22037-90
4.123	4	Receptacle Assembly - Retrograde and Adapter	45-79736-11	Cannon: 22037-91
4.124	1	Floodlight	45-79738-3	Grimes: 43315-A1-5004WW
4.125	1	Floodlight (Modified by 45-86040)	45-79738-4 *	Grimes: 43315-A2-5004WW
4.126	2	Limit Switch	45-79732-1	-
4.127	1	Switch Assembly	45-81358-1	-
4.128	1	Flashing Recovery Light and Power Supply	45-86702-11*	ACR Electronics:
4.129	1	Battery, Flashing Recovery Light	45-86702-9 *	ACR Electronics:
4.130	1	Maximum Altitude Sensor	45-87708-9	Donner Scientific 7005C
4.131	1	Thrust Cutoff Sensor	45-87709-5 *	Donner Scientific 4403-2-300-020
4.132	3	Fly-By-Wire Switch Assy.	45-61093-301	-
4.133	1	Harness Reel	45-82091-1	-

* To be shipped to launch site for installation

DATE 26 November 1962**MCDONNELL**

ST. LOUIS, MISSOURI

PAGE 117

REVISED _____

REPORT 6603-15A

REVISED _____

~~CONFIDENTIAL~~MODEL Mercury SpacecraftAPPENDIX I-CCONTRACTOR-FURNISHED EQUIPMENT - CONTRACTOR INSTALLEDAUTOMATIC STABILIZATION AND CONTROL SYSTEMIDENTIFICATION

<u>Item</u>	<u>Qty.</u>	<u>Nomenclature</u>	<u>M.A.C. No.</u>	<u>Minneapolis- Honeywell No.</u>
5	1	Automatic Stabilization and Control System, Consisting of:	45-87700-341	-
5.1	1	Attitude Gyro (Vertical)	45-87700-3 *	GG53E-3
5.2	1	Attitude Gyro (Directional)	45-87700-5	GG53E-4
5.3	1	Acceleration Switch	45-87700-15	GG118A-1
5.4	1	Rate Gyro (Pitch)	45-87700-51	GG79A-31
5.5	1	Rate Gyro (Roll)	45-87700-53	GG79A-32
5.6	1	Rate Gyro (Yaw)	45-87700-55	GG79A-33

* To be shipped to launch site for installation

DATE 26 November 1962

ST. LOUIS, MISSOURI

PAGE 118

REVISED _____

REPORT 6603-15A

REVISED _____

~~CONFIDENTIAL~~MODEL Mercury SpacecraftAPPENDIX I-CCONTRACTOR-FURNISHED EQUIPMENT - CONTRACTOR INSTALLEDREACTION CONTROL SYSTEMIDENTIFICATION

<u>Item</u>	<u>Qty.</u>	<u>Nomenclature</u>	<u>M.A.C. No.</u>	<u>Mfg. No.</u>
6	1	Reaction Control System Consisting of:	45-61700-78	Bell Aircraft
6.1	4	Valve, Check (5/16)	45-61700-51	8060-472-035-1
6.2	4	Valve, Check	45-61700-417	8060-472-010-1
6.3	2	Valve, Jettison	45-61700-482	8060-472-091-3
6.4	2	Bottle	45-61700-483	8060-471-002-3
6.5	1	Transducer, Manual	45-61700-489	8060-472-014-5
6.6	1	Transducer, Automatic	45-61700-490	8060-472-014-7
6.7	2	Valve, Manual Shutoff Low Pressure	45-61700-495	8060-472-009-3
6.8	1	Tank Assy., Automatic	45-61700-1179	8060-471-001-13
6.9	1	Tank Assy., Manual	45-61700-1181	8060-471-010-13
6.10	2	Valve, Relief (3/8")	45-61700-2081	Kidde-892462
6.11	4	T/C Assy., Pitch and Yaw, 24 Lb., Automatic (Modi- fied by 45-62110)	45-61700-2067	8060-470-012-1
6.12	2	Valve, Check - (6.1 Lb.)	45-61700-1151	Spartan Aircraft: C107-4-8C25
6.13	4	Valve, Check - (24-4 Lb.)	45-61700-1153	Spartan Aircraft: C107-5-6C25
6.14	4	T/C Assy., Pitch and Yaw 4-24 Lb., Manual	45-61700-1155	8060-470-133-5
6.15	3	Valve, Check	45-61700-1163	264T1-6T5T-.3

DATE 26 November 1962

ST. LOUIS, MISSOURI

PAGE 119

REVISED _____

REPORT 6603-15A

REVISED _____

MODEL Mercury SpacecraftAPPENDIX I-CCONTRACTOR-FURNISHED EQUIPMENT - CONTRACTOR INSTALLEDREACTION CONTROL SYSTEM - (Continued)IDENTIFICATION

<u>Item</u>	<u>Qty.</u>	<u>Nomenclature</u>	<u>M.A.C. No.</u>	<u>Mfg. No.</u>
6.16	1	Valve, Throttle, 1-6 Lb. (1/4") Manual	45-61700-1171	8060-472-038-131
6.17	2	Valve, Throttle, 4-24 Lb. Manual	45-61700-1172	8060-472-039-91
6.18	1	Valve, Manual Shutoff	45-61700-1409	8060-472-094-1
6.19	1	Valve, Manual Shutoff	45-61700-1411	8060-472-094-3
6.20	2	Valve, Manual Shutoff	45-61700-1415	8060-472-001-11
6.21	2	Valve, Relief	45-61700-1441	Kidde-892461
6.22	2	Filter	45-61700-1427	8060-472-004-3
6.23	2	Regulator Assembly	45-61700-1431 *	8060-472-120-3
6.24	2	Valve, Shutoff Manual Fill Vent	45-61700-2011	G.W. Dahl: 1228-04
6.25	4	Valve, Drain/Purge	45-61700-2029	G.W. Dahl: 1228-05
6.26	2	Valve, Manual Shutoff H ₂ O ₂	45-61700-2031 *	8060-472-023-5
6.27	3	Valve, Manual Shutoff, H ₂ O ₂	45-61700-2043	8060-472-024-5
6.28	1	T/C Assy., Roll, Lower (1 to 6 Lb.) Manual	45-61700-2077	8060-470-203-3
6.29	1	T/C Assy., Roll, Upper (1 to 6Lb.) Manual	45-61700-2078	8060-470-203-4

* To be shipped to launch site for installation

MCDONNELL

ST. LOUIS, MISSOURI

DATE 26 November 1962

REVISED _____

REVISED _____

PAGE 120REPORT 6603-15AMODEL Mercury SpacecraftAPPENDIX I-CCONTRACTOR-FURNISHED EQUIPMENT - CONTRACTOR INSTALLEDREACTION CONTROL SYSTEM - (Continued)IDENTIFICATION

<u>Item</u>	<u>Qty.</u>	<u>Nomenclature</u>	<u>M.A.C. No.</u>	<u>Mfg. No.</u>
6.30	4	T/C Assy., Pitch and Yaw 1 Lb., Auto (Mod. by 45-62110)	45-61700-2063	8060-470-190-13
6.31	1	T/C Assy., Roll Lower, (1 and 6 Lb.) Auto (Mod. by 45-62110)	45-61700-2065	8060-470-195-13
6.32	1	T/C Assy., Roll Upper, (1 and 6 Lb.) Auto (Mod. by 45-62110)	45-61700-2066	8060-470-195-14
6.33	1	Tank Assy., Auxiliary, H ₂ O ₂	45-61700-2073 *	8060-471-400-1

* To be shipped to launch site for installation

DATE 26-November 1962**MCDONNELL**

ST. LOUIS, MISSOURI

PAGE 121

REVISED _____

REPORT 6603-15A

REVISED _____

MODEL Mercury SpacecraftAPPENDIX I-CCONTRACTOR-FURNISHED EQUIPMENT - CONTRACTOR INSTALLEDCOMMUNICATIONS SYSTEMIDENTIFICATION

<u>Item</u>	<u>Qty.</u>	<u>Nomenclature</u>	<u>M.A.C. No.</u>	<u>Mfg. No.</u>
7		Communications System Consisting of:	45-85700-359	Collins
7.1	1	Transmitter-Receiver, HF Voice (Mod. By 45-85017)	45-85700-3	Collins: 522 1793 035
7.2	1	Panel, Control (Mod. By 45-85014)	45-85700-31	Collins: 522 1812 034
7.3	3	Antenna, S and C-Band	45-85700-33 *	Melpar: R436158-1A
7.4	1	Power Divider, C-Band (Mod. By 45-85038)	45-85700-35 *	Melpar: R530310-1A
7.5	1	Isolator, Bicone (Modi- fied By 45-78079)	45-85700-43	Collins: 522 1963 012
7.6	1	Antenna, UHF Descent	45-85700-49 *	Collins: 522 1817 015
7.7	1	Switch Coaxial (Mod. By 45-85031)	45-85700-51	Transco: 1460 233B
7.8	1	Diplexer, HF (Mod. By 45-85032)	45-85700-57	Collins: 522 1813 014
7.9	1	Amplifier, UHF Voice Power	45-85700-61	Collins: 522 1989 015
7.10	1	Transmitter-Receiver, UHF Voice (Mod. By 45-85019)	45-85700-63 *	Collins: 522 1851 025
7.11	1	Audio Center	45-85700-65 *	Andrea: AC 75E

* To be shipped to launch site for installation

MCDONNELLDATE 26 November 1962

ST. LOUIS, MISSOURI

PAGE 122

REVISED _____

REPORT 6603-15A

REVISED _____

MODEL Mercury SpacecraftAPPENDIX I-CCONTRACTOR-FURNISHED EQUIPMENT - CONTRACTOR INSTALLEDCOMMUNICATIONS SYSTEM - (Continued)IDENTIFICATION

<u>Item</u>	<u>Qty.</u>	<u>Nomenclature</u>	<u>M.A.C. No.</u>	<u>Mfg. No.</u>
7.12	1	Multiplexer (Mod. By 45-85029)	45-85700-71 *	Microphase: 7M769B-2
7.13	1	Power Divider, S-Band	45-85700-73 *	Melpar: R530311-1B
7.14	1	Beacon, HF/UHF Rescue	45-85700-75 *	Simmonds Aero: 311006B
7.15	1	Auxiliary UHF Rescue Beacon	45-85700-85 *	Simmonds Aero: 311016
7.16	1	Matching Network HF Whip	45-85700-89	Collins: 522 2362 004
7.17	1	Receiver, Command (Mod. By 45-85022)	45-85700-95	Motorola: 201 313 00F
7.18	1	Decoder, Command (Mod. By 45-85022)	45-85700-97	Motorola: 201 312 98D
7.19	1	Beacon, C-Band Radar (Mod. By 45-85026)	45-85700-109*	Avion: 152A 400-2
7.20	1	Beacon, S-Band Radar (Mod. By 45-85027)	45-85700-111*	Avion: 152A 900-4
7.21	1	Transmitter, Telemetry - Low Freq. (Mod. By 45-85042)	45-85703-5	EMR: 121B-6-M15
7.22	1	Power Supply, Telemetry	45-85703-7	EMR: 81-7929A
7.23	1	Switch, Coaxial, Manual (Mod. by 45-85043)	45-85707-1	Transco M1460-3

* These items to be shipped to launch site for installation.

DATE 26 November 1962**MCDONNELL**

ST. LOUIS, MISSOURI

PAGE 123

REVISED _____

REPORT 6603-15A

REVISED _____

~~CONFIDENTIAL~~MODEL Mercury SpacecraftAPPENDIX I-CCONTRACTOR-FURNISHED EQUIPMENT - CONTRACTOR INSTALLEDCOMMUNICATIONS SYSTEM - (Continued)IDENTIFICATION

<u>Item</u>	<u>Qty.</u>	<u>Nomenclature</u>	<u>M.A.C. No.</u>	<u>Mfg. No.</u>
7.24	1	Tone Generator, Alarm	45-85011-1	-
7.25	1	Antenna, HF Dipole	*	DeHavilland 5124F1-3
7.26	1	Communications Cable Assembly, Spacecraft to Raft	45-85044-301 *	-
7.27	1	Antenna Assembly, Aux. UHF Rescue Beacon	45-41022-1 *	-
7.28	1	Antenna, HF Rescue, 16-Foot	45-41024-1	Raymond Eng. Lab. 1529B-17

* To be shipped to launch site for installation

MCDONNELLDATE 26 November 1962

ST. LOUIS, MISSOURI

PAGE 124

REVISED _____

REPORT 6603-15A

REVISED _____

MODEL Mercury SpacecraftAPPENDIX I-CCONTRACTOR-FURNISHED EQUIPMENT - CONTRACTOR INSTALLEDENVIRONMENTAL CONTROL SYSTEMIDENTIFICATION

<u>Item</u>	<u>Qty.</u>	<u>Nomenclature</u>	<u>M.A.C. No.</u>	<u>AiResearch No.</u>
8	1	Environmental Control System Consisting of:	-	-
8.1	1	Installation, Coolant Lines	45-83006-315 *	-
8.2	1	Installation, ECS Lines	45-83060-321 *	-
8.3	1	Assembly, Tube	45-83069-1 *	-
8.4	1	Tank, Condensate	45-83076-301 *	-
8.5	1	Bottle Assembly, O ₂ , Secondary	45-83091-303	-
8.6	1	Valve, Snorkel Outflow	45-83121-1	-
8.7	1	Installation, Suit O ₂ Sampling	45-83131-1 *	-
8.8	1	Bottle Installation, Primary O ₂ , Including:	45-83179-1	-
8.8.1	1	Bottle Assembly, Oxygen, Primary #2	45-83700-427	134370-1
8.8.2	1	Bottle Assembly, Oxygen, Primary #1	45-83091-301	134292-1
8.9	1	Trap, Solids	45-83700-43 *	174310
8.10	2	Blower, Suit Circuit (Modified By 45-83122 and 45-83128)	45-83700-49	207970
8.11	5	Valve, Oxygen Check	45-83700-53**	123104-1

** 1 of this item modified to 45-83130 configuration.
2 of this item modified to 45-83147 configuration.

* To be shipped to launch site for installation

MCDONNELLDATE 26 November 1962

ST. LOUIS, MISSOURI

PAGE 125

REVISED _____

REPORT 6603-15A

REVISED _____

MODEL Mercury SpacecraftAPPENDIX I-CCONTRACTOR-FURNISHED EQUIPMENT - CONTRACTOR INSTALLEDENVIRONMENTAL CONTROL SYSTEM - (Continued)IDENTIFICATION

<u>Item</u>	<u>Qty.</u>	<u>Nomenclature</u>	<u>M.A.C. No.</u>	<u>AiResearch No.</u>
8.12	1	Tank, Cooling Water (Mod. By 45-83089)	45-83700-61	175320-1
8.13	1	Control Box (Mod. By 45-83095)	45-83700-65	510352
8.14	1	Valve, Ground Oxygen Inlet	45-83700-81	PS 137205
8.15	1	Valve, Suit Pressure Relief	45-83700-87	130100
8.16	1	Valve, Solenoid-Switch (Mod. By 45-83166)	45-83700-105 *	319190-2
8.17	1	Manifold, Suit Inlet	45-83700-175 *	174253
8.18	1	Duct, Cabin Evaporator Steam	45-83700-177 *	174363
8.19	1	Manifold, Compressor Outlet (Mod. By 45-83170)	45-83700-179	174479
8.20	1	Fitting, Suit Pressure Regulator Outlet	45-83700-181	174295
8.21	1	Duct, Water Separator Exit	45-83700-183 *	174364
8.22	1	Manifold, Compressor Inlet	45-83700-187	175767
8.23	1	Bracket, Cabin Pressure Control Valve	45-83700-193	174693
8.24	1	Valve, Snorkel Inflow (Mod. By 45-83103)	45-83700-211	121074-1
8.25	2	Gasket, Suit Heat Exchanger	45-83700-237 *	174247
8.26	1	2.5 Inch Marman Clamp	45-83700-255 *	4266

* To be shipped to launch site for installation

MCDONNELLDATE 26 November 1962

ST. LOUIS, MISSOURI

PAGE 126

REVISED _____

REPORT 6603-15A

REVISED _____

MODEL Mercury SpacecraftAPPENDIX I-CCONTRACTOR-FURNISHED EQUIPMENT - CONTRACTOR INSTALLEDENVIRONMENTAL CONTROL SYSTEM - (Continued)IDENTIFICATION

<u>Item</u>	<u>Qty.</u>	<u>Nomenclature</u>	<u>M.A.C. No.</u>	<u>AiResearch No.</u>
8.27	6	2.31 Inch Marman Clamp	45-83700-257	4365
8.28	1	2.68 Inch Marman Clamp	45-83700-259 *	4365
8.29	5	2.75 Inch Marman Clamp	45-83700-261	4365
8.30	6	"O"-Ring for Marman Clamp 4365-231	45-83700-265 *	S8057BE-265
8.31	1	"O"-Ring for Marman Clamp 4365-268	45-83700-267	S8057BE-245
8.32	10	"O"-Ring for Marman Clamp 4365-275	45-83700-269 *	S8057BE-208
8.33	1	"O"-Ring, CO ₂ Absorber and Evaporator	45-83700-271	S8057BE-268
8.34	3	"O"-Ring, System Shutoff Valves 122294 and Duct 174295	45-83700-273 *	S8496G-141
8.35	24	"O"-Ring	45-83700-277	S8469G-121
8.36	1	Valve, Pressure Test (Mod. By 45-83098)	45-83700-419	130098-2
8.37	1	Sensor, Blower Pressure Differential	45-83700-421	PS 207272-1
8.38	1	Blower, Cabin Equipment (Mod. By 45-83165)	45-83700-425 *	207990
8.39	1	Manifold, Solids Trap Exit	45-83700-437	173905
8.40	1	Duct Ground Vent Inflow	45-83700-443	175212

* To be shipped to launch site for installation

MCDONNELLDATE 26 November 1962

ST. LOUIS, MISSOURI

PAGE 127

REVISED _____

REPORT 6603-15A

REVISED _____

MODEL Mercury Spacecraft~~CONFIDENTIAL~~APPENDIX I-CCONTRACTOR-FURNISHED EQUIPMENT - CONTRACTOR INSTALLEDENVIRONMENTAL CONTROL SYSTEM - (Continued)IDENTIFICATION

<u>Item</u>	<u>Qty.</u>	<u>Nomenclature</u>	<u>M.A.C. No.</u>	<u>AIResearch No.</u>
8.41	2	Clamp Rings, 2.195 to 2.200 Dia.	45-83700-469	175346-1
8.42	1	Clamp Rings, 2.573 to 2.578 Dia.	45-83700-471 *	175346-2
8.43	5	Clamp Rings, 2.630 to 2.635 Dia.	45-83700-473 *	175346-3
8.44	1	Exchanger, Suit Circuit Heat (Mod. By 45-83096)	45-83700-479	174250-3
8.45	1	Exchanger, Cabin Equipment Heat	45-83700-481 *	174260-3
8.46	1	Valve, Dual Cabin Pressure Control and Pressurization	45-83700-485 *	102344-3
8.47	2	"O"-Rings for Plugs at CO ₂ Transducer Ports	45-83700-487 *	3-16
8.48	3	"O"-Rings for Outflow Ports of Cabin Pressure Regulator	45-83700-489 *	S8469G-6
8.49	1	Transducer, O ₂ Pressure	45-83700-495 *	512727
8.50	1	Assembly, Primary Oxygen Pressure Regulator (Mod. By 45-83191)	45-83700-841 *	132254-5
8.51	1	Assembly, Secondary Oxygen Pressure Regulator (Mod. By 45-83191)	45-83700-843 *	132256-4
8.52	6	Screw	45-83700-701 *	31363-4
8.53	1	Valve, Negative Pressure Relief (Mod. By 45-83011)	45-83700-703 *	130110-2

* To be shipped to launch site for installation

~~CONFIDENTIAL~~

DATE 26 November 1962

ST. LOUIS, MISSOURI

PAGE

128

REVISED _____

REPORT

6603-15A

REVISED _____

MODEL

Mercury Spacecraft

APPENDIX I-C

CONTRACTOR-FURNISHED EQUIPMENT - CONTRACTOR INSTALLED

ENVIRONMENTAL CONTROL SYSTEM - (Continued)

IDENTIFICATION

<u>Item</u>	<u>Qty.</u>	<u>Nomenclature</u>	<u>M.A.C. No.</u>	<u>AIResearch No.</u>
8.54	1	"O"-Ring on Boss for Pilot Suit Pressure Relief Valve	45-83700-705	3-8
8.55	2	Valve, Comfort Control	45-83700-711 *	121078-2
8.56	1	Absorber, Suit Circuit Water (Mod. By 45-83097)	45-83700-729 *	175830-3
8.57	1	Valve, System Shutoff (Mod. By 45-83126)	45-83700-741	122260-2
8.58	1	Valve, Relief, Cabin Pressure	45-83700-745 *	102416-10
8.59	1	Regulator, Suit Pressure	45-83700-831 *	132190-40
8.60	1	Valve, Post-Landing Outflow (Mod. by 45-83075)	45-83700-783	122216-2-1
8.61	1	Valve, Ground Ventilation Inlet	45-83700-785 *	122366-3-1
8.62	1	CO ₂ Absorber and Odor Control, Suit	45-83700-795 *	176080-1
8.63	1	Valve, Emergency O ₂ Rate	45-83700-797 *	132620-1
8.64	2	Valve, Check, Freon 114	45-83700-849 *	132632-1
8.65	2	Valve, Check, O ₂	45-83700-801 *	132638-1
8.66	1	Position Indicator, Water Separator	45-83198-1 *	177806
8.67	2	Valve, Shutoff, O ₂	45-83700-809 *	132424
8.68	1	Transducer, High Pressure	45-83700-825 *	538943
8.69	1	Standpipe Filter, Condensate Tank	45-83700-827	179330-1

* To be shipped to launch site for installation

MCDONNELLDATE 26 November 1962

ST. LOUIS, MISSOURI

PAGE 129

REVISED _____

REPORT 6603-15A

REVISED _____

~~CONFIDENTIAL~~MODEL Mercury SpacecraftAPPENDIX I-CCONTRACTOR-FURNISHED EQUIPMENT - CONTRACTOR INSTALLEDENVIRONMENTAL CONTROL SYSTEM - (Continued)IDENTIFICATION

<u>Item</u>	<u>Qty.</u>	<u>Nomenclature</u>	<u>M.A.C. No.</u>	<u>AIResearch No.</u>
8.70	1	Inflow Duct Check Valve Assy.	45-83130-301	-
8.71	1	Reducer	45-83700-835	-
8.72	1	Orifice	45-83700-845	-
8.73	1	Orifice	45-83700-847 *	-

* To be shipped to launch site for installation

MCDONNELLDATE 26 November 1962

ST. LOUIS, MISSOURI

PAGE 130

REVISED _____

REPORT 6603-15A

REVISED _____

MODEL Mercury SpacecraftAPPENDIX I-CCONTRACTOR-FURNISHED EQUIPMENT - CONTRACTOR INSTALLEDINSTRUMENTATION SYSTEMIDENTIFICATION

<u>Item</u>	<u>Qty.</u>	<u>Nomenclature</u>	<u>M.A.C. No.</u>	<u>Mfg. No.</u>
9		System, Instrumentation, Consisting of:	-	-
9.1	4	Assembly, Thermocouple	45-79012-15	-
9.2	9	Assembly, Thermocouple	45-79012-23	-
9.3	8	Assembly, Thermocouple	45-79012-51	-
9.4	4	Assembly, Thermocouple	45-79012-87 *	-
9.5	3	Assembly, Thermocouple	45-79012-121 *	-
9.6	8	Assembly, Thermocouple	45-79012-123	-
9.7	6	Assembly, Thermocouple	45-79012-125	-
9.8	8	Assembly, Thermocouple	45-79012-127	-
9.9	4	Assembly, Thermocouple	45-79012-129	-
9.10	4	Assembly, Thermocouple	45-79012-131	-
9.11	1	Instrumentation Package "A", Including:	45-88100-77 *	-
9.12	1	Timer, Retrograde Signal	45-88119-5 *	-
9.12.1	1	Power Supply, 3 Volt D.C.	45-88203-31 *	-
9.12.2	1	Assembly, Voltage Monitor	45-88205-19 *	-
9.12.3	1	Resistance Element, A.C. Power Supply	45-88206-9	-

* To be shipped to launch site for installation

DATE 26 November 1962

ST. LOUIS, MISSOURI

PAGE 131

REVISED _____

REPORT 6603-15A

REVISED _____

MODEL Mercury SpacecraftAPPENDIX I-CCONTRACTOR-FURNISHED EQUIPMENT - CONTRACTOR INSTALLEDINSTRUMENTATION SYSTEM - (Continued)IDENTIFICATION

<u>Item</u>	<u>Qty.</u>	<u>Nomenclature</u>	<u>M.A.C. No.</u>	<u>Mfg. No.</u>
9.12.4	1	Resistance Element, Amplifier	45-88207-9H *	-
9.12.5	1	Resistance Element, Amplifier	45-88207-39 *	-
9.12.6	1	Amplifier, Body Temperature	45-88215-27 *	-
9.12.7	1	Amplifier, D.C.	45-88215-29 *	-
9.12.8	1	O ₂ Partial Pressure Amp.	45-88221-17 *	-
9.12.9	1	Assembly, Instrumentation, Filter, Noise Amplifier Power	45-88228-1	-
9.12.10	1	Assembly, Instrumentation, Capacitor Card	45-88230-7	-
9.12.11	1	Assembly, Instrumentation, Converter, D.C. Signal	45-88248-5 *	-
9.12.12	1	Commutator, Keyer	45-88728-1	Applied Electronics: 340-23-2
9.12.13	1	Transformer, Filament	-	Comm. Accessories: 76-0056-35
9.13	1	Instrumentation Package "C", Including:	45-88102-51 *	-
9.13.1	1	Solenoid Voltage Attenuator	45-88205-3 *	-
9.13.2	1	Amplifier, Horizon Scanner	45-88212-17 *	-
9.13.3	1	Assembly, Instrumentation, Rate Signal Filter and Calibrate Card	45-88214-31 *	-

* To be shipped to launch site for installation

DATE 26 November 1962

ST. LOUIS, MISSOURI

PAGE 132

REVISED _____

REPORT 6603-15A

REVISED _____

MODEL Mercury Spacecraft

APPENDIX I-C

CONTRACTOR-FURNISHED EQUIPMENT - CONTRACTOR INSTALLED

INSTRUMENTATION SYSTEM - (Continued)

IDENTIFICATION

<u>Item</u>	<u>Qty.</u>	<u>Nomenclature</u>	<u>M.A.C. No.</u>	<u>Mfg. No.</u>
9.13.4	1	Assembly, Instrumentation, Solenoid/Rate Signal Mixer	45-88238-5 *	-
9.13.5	1	Assembly, Instrumentation, Temperature Alarm	45-88250-7 *	-
9.13.6	1	Assembly, Instrumentation, Thermistor Signal Conditioner	45-88251-1 *	-
9.13.7	1	Assembly, Instrumentation, Solenoid Malfunction Detector	45-88252-1 *	-
9.13.8	1	Transducer, Cabin Pressure	45-88705-9	CEC: 4-380MUB-15A
9.14	1	Navigation Reticle	45-88118-1 *	-
9.15	1	Sensor Assembly, Heat Exchanger, Cabin Outlet	45-83200-1 *	FENWAL: GB34P91 Yellow Springs: 40012
9.16	1	Camera, Utility 16 mm; (Including Three Lenses)	45-88121-1*	-
9.17	6	Magazine, Film, 16 mm	*	-
9.18	1	Instrumentation Package "D", Including:	45-88113-19	-

* These items to be shipped to launch site for installation.

DATE 26 November 1962

ST. LOUIS, MISSOURI

PAGE 133

REVISED _____

REPORT 6603-15A

REVISED _____

~~CONFIDENTIAL~~

MODEL Mercury Spacecraft

APPENDIX I-C

CONTRACTOR-FURNISHED EQUIPMENT - CONTRACTOR INSTALLED

INSTRUMENTATION SYSTEM - (Continued)

IDENTIFICATION

<u>Item</u>	<u>Qty.</u>	<u>Nomenclature</u>	<u>M.A.C. No.</u>	<u>Mfg. No.</u>
9.18.1	1	Resistor Panel	45-88233-21 *	-
9.18.2	1	Resistor Panel	45-88233-23 *	-
9.18.3	1	Resistor Panel	45-88233-25 *	-
9.18.4	1	Isolation Amplifier	45-88234-3 *	-
9.18.5	1	Accelerometer Filter	45-88241-23 *	-
9.18.6	1	Voltage Controlled Oscillator 0.4KC	45-88243-1	EMR: 184C-0.40 2.5K-20-M10
9.18.7	1	Voltage Controlled Oscillator 0.56KC	45-88243-3	EMR: 184C-0.56
9.18.8	1	Voltage Controlled Oscillator 0.73KC	45-88243-5	EMR: 184C-0.73
9.18.9	1	Voltage Controlled Oscillator 1.30KC	45-88243-7	EMR: 184C-1.30
9.18.10	1	Voltage Controlled Oscillator 1.70KC	45-88243-9	EMR: 184C-1.70
9.18.11	1	Voltage Controlled Oscillator 2.30KC	45-88243-11	EMR: 184C-2.30
9.18.12	1	Voltage Controlled Oscillator 3.00KC	45-88243-13	EMR: 184C-3.00
9.18.13	1	Voltage Controlled Oscillator 3.90 KC	45-88243-15	EMR: 184C-3.90
9.18.14	1	Voltage Controlled Oscillator 10.361KC	45-88243-19	EMR: 184C-10.361
9.18.15	1	Assembly, Instrumentation, VCO Power Regulator	45-88245-1	-

* To be shipped to launch site for installation

MCDONNELL

ST. LOUIS, MISSOURI

DATE 26 November 1962PAGE 134

REVISED _____

REPORT 6603-15A

REVISED _____

MODEL Mercury SpacecraftAPPENDIX I-CCONTRACTOR-FURNISHED EQUIPMENT - CONTRACTOR INSTALLEDINSTRUMENTATION SYSTEM - (Continued)IDENTIFICATION

<u>Item</u>	<u>Qty.</u>	<u>Nomenclature</u>	<u>M.A.C. No.</u>	<u>Mfg. No.</u>
9.18.16	1	Accelerometer "Z" Axis +30g	45-88712-3	Donner: 4310-1
9.18.17	2	EKG Amplifier	45-88726-1 *	Thompson-Ramo Wooldridge
9.19	1	Transducer, Static Pressure	45-88705-5	CEC: 4-380MUA-15A
9.20	1	Transducer, Suit Pressure	45-88705-9	CEC: 4-380MUA-15A
9.21	2	Transducer, N ₂ Low Pressure (H ₂ O ₂ Pressure)	45-88705-13	-
9.22	1	Sensor, Cabin O ₂ Partial (Modified By 45-88115)	45-88706-21	Thompson-Ramo Wooldridge
9.23	1	Programmer	45-88710-13	Wheaton: M-112-7B
9.24	1	Probe, Temperature	45-88720-3	Transonics, Inc.: 1182B
9.25	1	Kit, Instrumentation	45-88999-39 *	
9.26	1	Pressure Switch (Modified By 45-88117)	45-88724-15 *	Lourdes Hydraulic: LH 10280-4
9.27	1	System, Blood Pressure Measuring	45-88727-145 *	Garrett Corp.: 54778-6
9.28	1	Assembly, Instrumentation, Astronaut Transducer, Consisting of:	45-88822-19*	-
9.28.1	1	Probe, Body Temperature	45-88814-11*	Gulton Industries: 32PB24B

* These items to be shipped to launch site for installation.

MCDONNELLDATE 26 November 1962

ST. LOUIS, MISSOURI

PAGE 135

REVISED _____

REPORT 6603-15A

REVISED _____

MODEL Mercury SpacecraftAPPENDIX I-CCONTRACTOR-FURNISHED EQUIPMENT - CONTRACTOR INSTALLEDINSTRUMENTATION SYSTEM - (Continued)IDENTIFICATION

<u>Item</u>	<u>Qty.</u>	<u>Nomenclature</u>	<u>M.A.C. No.</u>	<u>Mfg. No.</u>
9.28.2	6	EKG Pickup	45-88821-17*	-
9.28.3	1	Impedance Pneumograph	45-88122-1	-
9.29	10	Assembly, Instrumentation, Temperature Pickup	45-88891-1*	Fenwal: GB34P91
9.30	2	Assembly, Instrumentation, Temperature Pickup	45-88891-13 *	-
9.31	2	Transducer, Ablation Shield Temperature	45-88859-3	Ruge: 6608
9.32	1	Assembly, Instrumentation, Temperature Pickup, Suit Inlet Air	45-88868-13 *	-
9.33	1	Assembly, Instrumentation, Tape Recorder, Consisting of:	45-88871-47 *	-
9.33.1	1	Tape Recorder, Including:	45-88707-303*	Consolidated Electrodynamics: (CEC) 176217
9.33.1.1	1	Speed Change Kit (1-7/8 ips)	45-88707-13 *	CEC: 176127
9.33.1.2	1	Transport Assembly	45-88707-15 *	CEC: 176170
9.33.1.3	2	Reel	45-88707-17*	CEC: 176001
9.33.1.4	6250 Ft.	Tape, 1/2 Inch	*	Minn. Mining & Mfg.: 490
9.33.2	1	Direct Record Amplifier Kit	45-88707-7 *	CEC: 176160

* These items to be shipped to launch site for installation.

DATE 26 November 1962
REVISED _____
REVISED _____

MCDONNELL

ST. LOUIS, MISSOURI

PAGE 136
REPORT 6603-15A
MODEL Mercury Spacecraft

APPENDIX I-C

CONTRACTOR-FURNISHED EQUIPMENT - CONTRACTOR INSTALLED

INSTRUMENTATION SYSTEM - (Continued)

IDENTIFICATION

<u>Item</u>	<u>Qty.</u>	<u>Nomenclature</u>	<u>M.A.C. No.</u>	<u>Mfg. No.</u>
9.34	3	Assembly, Instrumentation Potentiometer	45-88893-3	General Control: PRA2154XX199
9.35	1	Transducer, Suit Inlet Temp.	- *	Ruge: BN-274
9.36	3	Sensor, Reference Junc- tion Temperature	-	FENWAL: GB34P91
9.37	**	Panel Assembly, VCO, Stick Position	45-78099-1 *	-
9.37.1	1	Voltage Controlled Oscillator 0.56 KC	45-88243-3	EMR: 184C-0.56
9.37.2	1	Voltage Controlled Oscillator 0.73 KC	45-88243-5	EMR: 184C-0.73
9.37.3	1	Voltage Controlled Oscillator 1.30 KC	45-88243-7	EMR: 184C-1.30

* To be shipped to launch site for installation

** See Item 4.33 for quantity

MCDONNELLDATE 26 November 1962

ST. LOUIS, MISSOURI

PAGE 137

REVISED _____

REPORT 6603-15A

REVISED _____

MODEL Mercury SpacecraftAPPENDIX I-CCONTRACTOR-FURNISHED EQUIPMENT - CONTRACTOR INSTALLEDLANDING AND POST-LANDING SYSTEMSIDENTIFICATION

<u>Item</u>	<u>Qty.</u>	<u>Nomenclature</u>	<u>M.A.C. No.</u>	<u>Radioplane No.</u>
10		Landing and Post-Landing System, Consisting of:	45-41700	-
10.1	1	Drogue Bag	45-41700-11*	R-5104
10.2	1	Mortar Sabot	45-41700-19*	R-5126
10.3	1	Drogue Chute	45-41700-29*	R-5103-309
10.4	2	Bag, Landing Parachute Ejector	45-41700-37*	R-5118-301
10.5	1	Shear Pin, Pilot Chute Deploy Gun	45-41700-63*	101070-17
10.6	2	Strap Assembly, Adjustable Retaining	45-41700-101	R-5195
10.7	1	Strap, Nonadjustable, Insulated	45-41700-117	R-5196
10.8	1	Projectile Assembly, Pilot Chute Deploy Gun	45-41700-127 *	101070-23
10.9	1	Mortar Tube	45-41700-143	R-5109-305
10.10	1	Lanyard, Pilot Chute	45-41700-149*	R-5136-301
10.11	2	Baroswitch, 10,600 Ft. (Mod. By 45-41036)	45-41700-163	101080-15
10.12	1	Cartridge, Main Charge, Deployment Gun	45-41700-167*	101070-31
10.13	1	Body Assembly, Gun, Pilot Chute Deploy (Mod. By 45-41034)	45-41700-171	101070-33

* These items to be shipped to launch site for installation.

MCDONNELLDATE 26 November 1962

ST. LOUIS, MISSOURI

PAGE 138

REVISED _____

REPORT 6603-15A

REVISED _____

MODEL Mercury SpacecraftAPPENDIX I-CCONTRACTOR-FURNISHED EQUIPMENT - CONTRACTOR INSTALLEDLANDING AND POST-LANDING SYSTEMS - (Continued)IDENTIFICATION

<u>Item</u>	<u>Qty.</u>	<u>Nomenclature</u>	<u>M.A.C. No.</u>	<u>Radioplane No.</u>
10.14	1	Lanyard, Antenna	45-41700-181*	R-5135-311
10.15	2	Disconnect, Landing Parachute	45-41700-191	R-5127-301
10.16	1	Pilot Parachute	45-41700-193*	R-5204-305
10.17	4	Cutter, Reefing - 4 Second	45-41700-267*	58170-4
10.18	2	Cutter, Reefing, 16 Second	45-41700-197*	101092-13
10.19	2	Reefing Line	45-41700-265*	R-5157-111
10.20	1	Bridle, Parachute	45-41700-201*	R-5205-301
10.21	1	Packet Assembly, Shark Repellent	45-41700-203*	R-5206
10.22	2	Squib Cartridge, Electric, Parachute Disconnect	45-41700-209*	58080
10.23	1	Squib Cartridge, Electric, Drogue Mortar	45-41700-211*	58081
10.24	1	Squib Cartridge, Electric, Deployment Gun	45-41700-213*	58082
10.25	1	Bag, Main Chute Deployment	45-41700-261*	R-5116-313
10.26	1	Bag, Reserve Chute Deployment	45-41700-263*	R-5117-313
10.27	1	Packet Assembly, Fluorescein Dye Marker	45-41700-231*	R-5208

* These items to be shipped to launch site for installation.

~~CONFIDENTIAL~~

MCDONNELLDATE 26 November 1962

ST. LOUIS, MISSOURI

PAGE 139

REVISED _____

REPORT 6603-15A

REVISED _____

MODEL Mercury SpacecraftAPPENDIX I-CCONTRACTOR-FURNISHED EQUIPMENT - CONTRACTOR INSTALLEDLANDING AND POST-LANDING SYSTEMS - (Continued)IDENTIFICATION

<u>Item</u>	<u>Qty.</u>	<u>Nomenclature</u>	<u>M.A.C. No.</u>	<u>Radioplane No.</u>
10.28	1	Bridle, Pilot Parachute	45-41700-237*	R-5153-301
10.29	2	Landing Parachute	45-41700-259*	R-5157-333
10.30	2	Baroswitch, 21,000 Ft. (Mod. By 45-41036)	45-41700-245	101080-21
10.31	1	Gas Generator Assembly, Main Chute	45-41700-247*	R-5211-1
10.32	1	Gas Generator Assembly, Reserve Chute	45-41700-249*	R-5211-3
10.33	1	Switch, Inertia	45-41700-251	58215-307
10.34	1	Container Assembly, Parachute	45-41010-307	-
10.35	1	Cover, Mortar	45-41014-1	
10.36	1	Bag, SOFAR Bomb	45-41700-227 *	R-5207

* These items to be shipped to launch site for installation.

DATE 26 November 1962

ST. LOUIS, MISSOURI

PAGE 140

REVISED _____

REPORT 6603-15A

REVISED _____

MODEL Mercury SpacecraftAPPENDIX I-CCONTRACTOR-FURNISHED EQUIPMENT - CONTRACTOR INSTALLEDPYROTECHNIC SYSTEM*IDENTIFICATION

<u>Item</u>	<u>Qty.</u>	<u>Nomenclature</u>	<u>M.A.C. No.</u>	<u>Mfg. No.</u>
11		Pyrotechnic Devices, Consisting of:	-	-
11.1	1	Explosive Assembly, Emergency Egress Hatch	45-35701-301	Minneapolis- Honeywell: EX 511838
11.2	**	Cartridge, Deployment Gun	45-41700-167	-
11.3	**	Cutter, Reefing, 4-Second Time Delay	45-41700-267	-
11.4	**	Squib Cartridge, Parachute Disconnect	45-41700-209	-
11.5	**	Squib Cartridge, Drogue Mortar	45-41700-211	-
11.6	**	Squib, Deployment Gun	45-41700-213	-
11.7	**	Gas Generator, Main Chute	45-41700-247	-
11.8	**	Gas Generator, Reserve Chute	45-41700-249	-
11.9	**	Valve (Heat Shield Release and Auxiliary Fuel Valves)	45-61700-482	-
11.10	4	Explosive Bolt, Clamp Ring	45-72702-19	Olin Mathieson: 112C-7
11.11	2	Explosive Bolt, Clamp Ring	45-72702-23	Olin Mathieson: 116C-3
11.12	1	Explosive Bolt, Retrograde	45-72704-9	Olin Mathieson: 113C-3

* Pyrotechnic devices to be shipped to launch site for installation.

** Quantities defined under applicable systems.

MCDONNELLDATE 26 November 1962

ST. LOUIS, MISSOURI

PAGE 141

REVISED _____

REPORT 6603-15A

REVISED _____

MODEL Mercury SpacecraftAPPENDIX I-CCONTRACTOR-FURNISHED EQUIPMENT - CONTRACTOR INSTALLEDPYROTECHNIC SYSTEM* - (Continued)IDENTIFICATION

<u>Item</u>	<u>Qty.</u>	<u>Nomenclature</u>	<u>M.A.C. No.</u>	<u>Mfg. No.</u>
11.13	10	Explosive Cell	45-72705-5	Beckman-Whitley: 10084
11.14	5	Ring Assembly	45-72705-7	Beckman-Whitley:
11.15	1	Explosive Cell (Snorkel Inlet Door Actuation)	45-72707-5	McCormick Selph: 3625
11.16	2	Cartridge	45-72708-303	-
11.17	1	Cartridge	-	McCormick Selph: 2561
11.18	1	Cartridge	-	Frankford Arsenal: M67E1
11.19	4	Initiator (Chute Deploy, Capsule and Tower Separation)	-	Frankford Arsenal: XM-41
11.20	1	Squib (Whip Antenna)	-	Raymond Eng. Lab. 1529 E-21
11.21	2	Cutter, Reefing, 16-Second Time Delay	-	Ordinance Associates: OA-02-4
11.22	1	Cutter, Coax, Dipole Antenna	45-72710-3	-
11.23	1	Cartridge, Cutter, Coax., Dipole Antenna	45-72710-5	-
11.24	1	Squib, Dipole Antenna Extend	45-83719	-
11.25	1	SOFAR Bomb, 2500-Foot	45-41700-269	-

* Pyrotechnic devices to be shipped to launch site for installation